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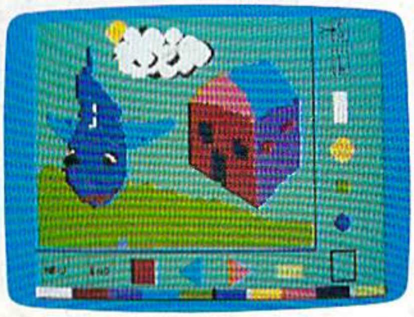

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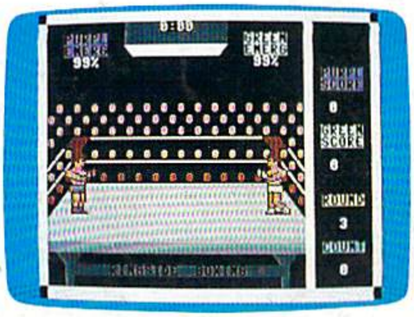

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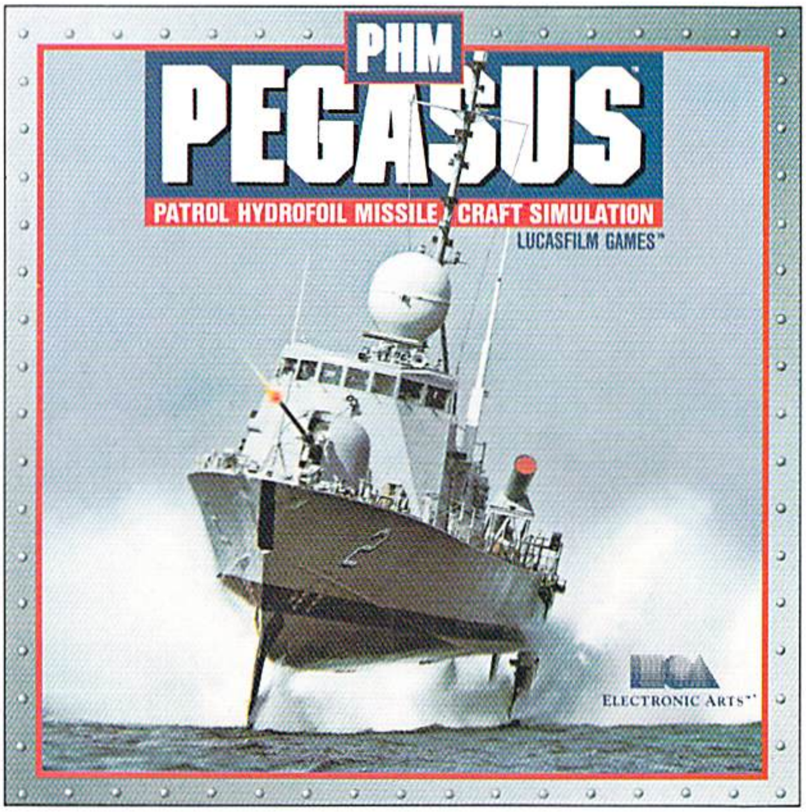

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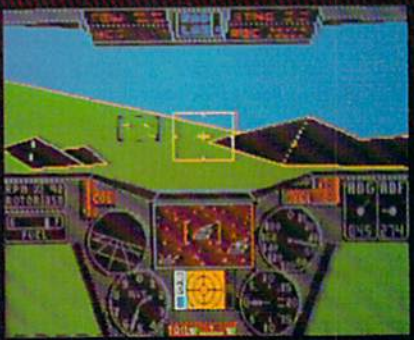

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editor's notes

The following editor's notes are reprinted from the February issue of COMPUTE!.

This is the 81st issue of COMPUTE!, an effort now in its ninth year. Writing the "Editor's Notes" for all of those years has been a fascinating challenge. When you add to this the 43 issues of COMPUTE!'s Gazette (through January 1987), and a few assorted odds and ends such as *Home and Educational Computing, COMPUTE!'s PC & PCjr Magazine, COMPUTE!'s Apple Applications Special*, and another special issue here and there, you discover a quiltwork of topics that extend back through much of the history of the home and consumer computing industry.

The topic for this issue is a highly personal one. This is my last set of notes as Editor in Chief of COMPUTE!. Beginning next issue, Richard Mansfield, presently Senior Editor and soon to become Vice President and Editorial Director, will take over the task of providing editorial leadership, and "Editor's Notes," for all of COMPUTE! Publications. Richard has been very much a part of COMPUTE! and its vision and voice since he joined us in 1981.

My own relationship with COMPUTE!, as founder, President, Chief Executive Officer, and finally Editor in Chief, has been in a state of beneficial evolution since we sold the company to the American Broadcasting Companies in 1983. As my relationship has evolved, so too has the industry, and our present marketplace is far stronger than it was even two years ago. I remain very much a part of the ABC Consumer Magazines/ COMPUTE! Publications effort, and will continue to lend my voice and experience to this company. At the same time, my diminishing involvement in the day-to-day activities of the company and its management will allow me the time to explore new horizons—a challenge I can only look forward to.

COMPUTE! and ABC Publishing share a long tradition of customer enthusiasm and loyalty. We are at the forefront of product introductions that continue to keep us and our readers at a pace with the evolution of our industry. We were among the first of the publishing houses to commit to the validity and future of the home computer market, and you have never let us down. While we have been occasionally sharp in print over the ebbs and flows of certain manufacturers and their products, we have enjoyed a long and pleasant vantage point on this industry. When I wrote my very first COMPUTE! editorial, a company called Atari, Inc. had just introduced its first computers. Single-board computers were big. And Ohio Scientific was threatening to become one of the biggest players in the industry. Commodore had introduced a computer with a "real" keyboard (the CBM) and a then-incredible 32K of memory. The top magazines in the industry had names like *Kilobaud, Micro, Creative, Recreational Computing*, and others. Only a few remain.

From the very first issue of this magazine, we've had a unique relationship with you, our readers. You've been supportive; you've encouraged; you've sometimes grown angry, but usually for the best of reasons: We were late delivering your issue, or we stepped on the toes of your particular computer manufacturer. In all candor, I cannot imagine an industry with a more vital and resourceful readership than an industry such as ours. We have readers/ authors from ages 8–80, from all over the world, who are shaping the face of this industry and our future, and opportunities like that simply don't happen very often. Personal computing is a highly individual revolution, and its publishing shape and practices have in many ways reflected that.

So, I guess that's it. With this last editorial (oh, perhaps I'll write a guest one or so next year) I'd like to send a very personal thank-you to each and every one of you, our readers.

Robert C. Lock

Robert C. Lock
Founder, Editor in Chief

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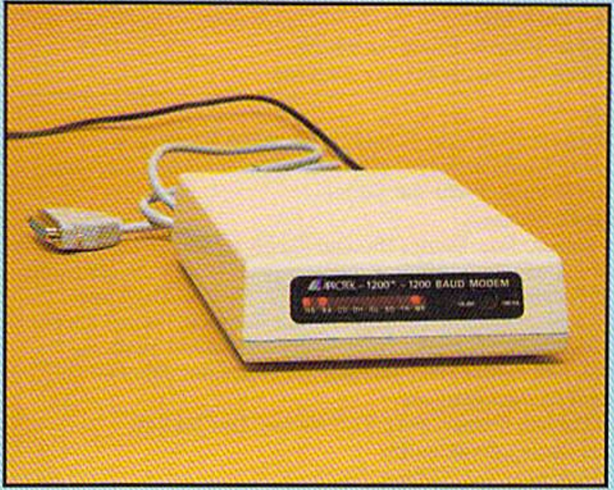

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Do you have a question or a problem? Have you discovered something that could help other Commodore users? We want to hear from you. Write to Gazette Feedback, COMPUTE!'s Gazette, P.O. Box 5406, Greensboro, NC 27403. We regret that due to the volume of mail received, we cannot respond individually to programming questions.

Printing Biorhythms

I have a biorhythm program which was originally written for the PET/CBM computer and was converted to work on the 64. It only prints to the screen. How can I make it print to a printer?

Ruth Welzen

The CMD statement allows you to divert output to a previously opened file. To send output to the printer instead of the screen, you could try adding this line to the beginning of your program:

```
10 OPEN 1,4: CMD 1
```

Then, at the end of the main routine, add this line:

```
499 PRINT#1: CLOSE 1
```

The OPEN statement opens a file to the printer, and CMD rechannels to the printer all output that would otherwise go to the screen. If you'd prefer to see the results in upper/lowercase mode, change the first line to OPEN 1,4,7.

This technique may not work, however. There are times when CMD will fail; if the GET statement is found anywhere in the program, all output after the GET will go to the screen instead of the printer.

To insure that everything is printed to the printer, you should place the OPEN command at the beginning and then go through the program, changing all occurrences of PRINT to PRINT#1, (be sure the comma follows the number 1). To send output back to the screen, change the first line to OPEN 1,3. The screen is device 3.

This technique, too, may not work. If the program POKEs the biorhythm chart directly to the screen, there are no PRINT statements to intercept.

GAZETTE Disk Problems?

I own both a 64 and a portable SX-64. The GAZETTE Disks work as they should on the 64, but not on the SX-64. Some of the programs load OK, but then the screen goes blank. Is there some modification that I can make to use the programs on my portable 64?

Tony Vecchi

When you turn on the 64, the screen is blue. The SX-64 starts out with a white screen. Some of the programs on the GAZETTE Disk change the character color to white because white on blue provides a better contrast of colors, especially for readers who have their 64 hooked up to monochrome monitors or black-and-white televisions. But white characters on the SX-64's white screen are impossible to read.

If you'll enter POKE 53281,6 before loading the disk menu, you won't be facing a blank screen. The programs should run fine if you change the screen color to blue.

Snooze Alarm

I've been using a certain filing program for over a year and until now I've been very happy with it. But I've run across a major problem. The more files I have stored in the program the longer it takes to print them out. It takes 22 hours to print 470 files. Three files will print, followed by a ten-minute pause, then three more will print, and so on.

Is there a way to speed up this process? It's hard to sleep with a printer interrupting every ten minutes.

Gary Ciuffetelli

Not knowing more about how the program runs, we can only guess at a solution.

First try this: Run the program and start printing the files. When the ten-minute pause begins, put your hand on the disk drive. Can you feel the disk drive spinning for the whole ten minutes? If so, the slowdown can be blamed on disk access time. The program spends the ten minutes reading through the file searching for the files to print. There's not much you can do about speeding up the disk drive. You might gain some time with a turbo-disk type of program, or by using a 128 and 1571 drive, or by rewriting the program to use relative files instead of sequential files.

If the disk drive whirs for a while and then falls silent, the delay is probably caused by something the program is doing slowly. It might be performing complicated calculations, in which case you'd probably have to rewrite parts of the program to speed it up.

It might very well be a problem with "garbage collection" of strings. If garbage collection is the culprit, you can quickly and easily solve the problem with the short machine language program called "Sanitation Engineer," from last month's "Power BASIC" column.

Strange Exponents

While using my 64 for math homework, I have run into a problem. When raising a variable containing a negative number to a fractional exponent, the computer gives an ?ILLEGAL QUANTITY ERROR. It does not happen with constants. For example, PRINT −8 ↑ .5 will work, but X = −8: PRINT X ↑ .5 does not. Why is this?

Guy Keller

*Computers follow a rule called "order of operations" or "operator precedence," which tells them which functions or operations to perform before others. For example, PRINT 3 + 2 * 7 will give you a result of 17, not 35, because multiplication has a higher precedence than addition. The result of 2 * 7 is calculated before the 3 is added in.*

The up-arrow function (↑) has a higher precedence than the negation (−) function, as you'll see if you PRINT −4 ↑ 2. The 64 prints −16 as the answer. But squaring −4 should result in a positive (not a negative) 16. What happens is that the result of 4 ↑ 2 is calculated first; then the minus sign is appended.

Although PRINT −8 ↑ .5 seems to work, you'll get an error message if you try PRINT (−8) ↑ .5. So it's not a matter of variables versus constants; it's strictly a problem with raising a negative number to a fractional power.

Raising to the .5 power is the same as finding the square root of a number. The square root of −8 would have to be a number that multiplied by itself yielded −8. But whenever you square a real number, the result is positive, so there's no such thing as a square root of a negative number, at least among the real numbers. Mathematicians use imaginary numbers *to handle square roots of negative numbers, but your 64 isn't built to handle imaginary numbers.*

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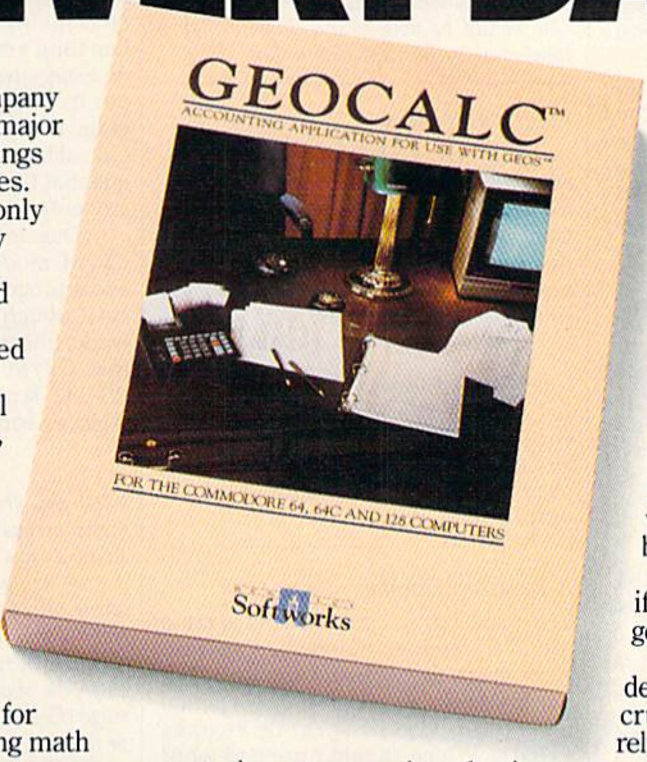

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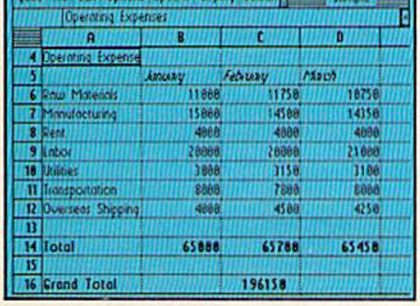

	A	B	C	D
4	Operating Expense			
5		January	February	March
6	Raw Materials	11000	11750	10750
7	Manufacturing	15000	14500	14350
8	Rent	4000	4000	4000
9	Labor	20000	20000	21000
10	Utilities	3000	3150	3100
11	Transportation	8000	7800	8000
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13				
14	Total	65000	65700	65450
15				
16	Grand Total		196150	

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A Program Rewrites Itself

I am not very knowledgeable where computers are concerned, so I don't really know how to ask this question. Enclosed is a program where line 80 should read NEXTJ instead of NEXTG and the G in line 75 should be a semicolon. If I correct these two lines, then run the program, the Gs come back. Why?

Roderick Moore

Screen memory takes up 1000 bytes at locations 1024–2023 on the 64. If you POKE to any one of these bytes, a character appears in the corresponding spot on the screen. Just beyond the screen, from locations 2049–40959, you'll find the memory that holds BASIC programs.

There are two places in your program where the line POKE Q,71 appears. From the way the variable Q is calculated, it's clear that the purpose of the POKE is to put a graphics character on the screen. But at some point, the variable Q is assigned a value that's past the end of screen memory, in the realm of the BASIC program. Since the number 71 is the ASCII code for the letter G, *the result is spurious* Gs *sprinkled throughout your program.*

One way to solve the problem is to trace through the program by hand and figure out how the variable Q is changed by various lines in the program. Another debugging technique that might take less time is to insert the following commands on a separate line before the POKE statements:

```
117 PRINT Q: IF (Q<1024)OR(Q>2023)
    THEN STOP
```

By watching the values of Q change, you may be able to figure out where the program has gone astray. When you've figured out what went wrong, you can fix it and remove the line above.

Converting To The 128

I recently upgraded from a 64 and 1541 to a 128 and 1571 and have a few questions.

I have a simple BASIC program for the 64 that uses POKE 211,X and POKE 214,Y to locate the cursor before printing the result of a problem. The POKEs don't work properly in 128 mode, and I'd like to know the equivalents.

Second, I understand that the 128's CP/M mode is fully compatible with the Kaypro IV. But I've seen a spreadsheet program that leaves many zeros on the screen. Is it possible that an updated version of CP/M will cure this problem?

Finally, I have plans to use a Sony monitor with my 128 and would like technical details about the pinouts. A technical spec sheet is enclosed.

Jacob Philip

To move the cursor to a specific x and y position on the 128, you may use the CHAR command—CHAR 1,X,Y for example. Although CHAR seems to have been created to put text on the hi-res screen, it also works as a sort of PRINT-AT command on both 40- and 80-column text screens. You could also use the Kernal PLOT routine BANK15: SYS 65520,0,Y,X,0.

You may not be able to solve the problem you're having with the Kaypro program. The standard defined by CP/M provides a set of entry points for routines that print to the screen, read and write to the disk, and so on. As long as the program uses these BIOS and BDOS calls, it should work in CP/M mode on your 128. But some programs don't use the standard entry points; routines can be written that take advantage of machine-specific features of a computer. The programmer trades compatibility for speed. This may be the case with the spreadsheet you have. In other words, it's not really a CP/M program; it's a Kaypro-only program.

The technical page you included about the monitor mentions PC/PCjr compatibility. Since the 128's 80-column RGB port is the same as the IBM PC's RGB port, you should be able to use a cable that is labeled as being IBM-compatible.

Plus/4 Reference

I am an owner of a Plus/4 computer. Since there is so little software available for my computer, I often try to translate 64 programs. One problem I have is that I don't know how to find the various ROM routines. Do you know of any source of these routines?

Martin Gelb

One book that seems to have most of what you need is The Programmer's Reference Guide for the Commodore Plus/4 *by Cyndie Merten and Sarah Meyer. It is published by Scott, Foresman and Company, Glenview, Illinois.*

A Random Choice

I've made a program in which I want to use real random numbers. I've read somewhere that I should use RND(TI), but in almost all program listings that I've seen, the programmer uses RND(1). Which should I use and why?

Stefan Roos

The number inside parentheses is called the argument *and it determines the types of numbers returned by the RND function. The random function responds differently to three types of arguments—positive, negative, and zero.*

RND(0) returns a number generated from certain hardware locations in the 64. The range for these numbers is limited, so RND(0) doesn't make a good random-number generator.

A positive nonzero value, such as 1, returns a number generated from a sequence of random numbers. These numbers are very close to being truly random—that's why RND(1) is used so often. But, at power-up, RND(1) always begins the same sequence of numbers. The solution to this problem is to use a negative argument for RND at the start of a program.

A negative argument always starts a new sequence of random numbers. The same negative number always starts the same sequence of numbers—this can be used to your advantage while you're debugging your program. If you're programming a game, you don't want the same sequence of random numbers to appear each time the player turns on the computer. A procedure that starts with an unpredictable random-number sequence is to use RND(−TI) once at the start of a program to select the sequence of numbers. Afterwards, use RND(1). This procedure uses the system timer to select the random-number sequence.

A String Full Of Nothing

I'm writing a program on my 128 using 80 columns and I'm having a problem handling arrays. If no data is entered in an array, the data doesn't stay where I put it. The first time through the program, everything is where it should be. On each subsequent reading of the sequential file, data shifts to the left to fill any empty arrays.

One more question: When I'm in CP/M mode, using my 1650 modem and a program called IMP.COM, I can't get through to any BBS. The modem works fine in 64 mode. A friend told me that CP/M modems work only with RS-232–type modems. Do I need to buy a Hayes-compatible modem?

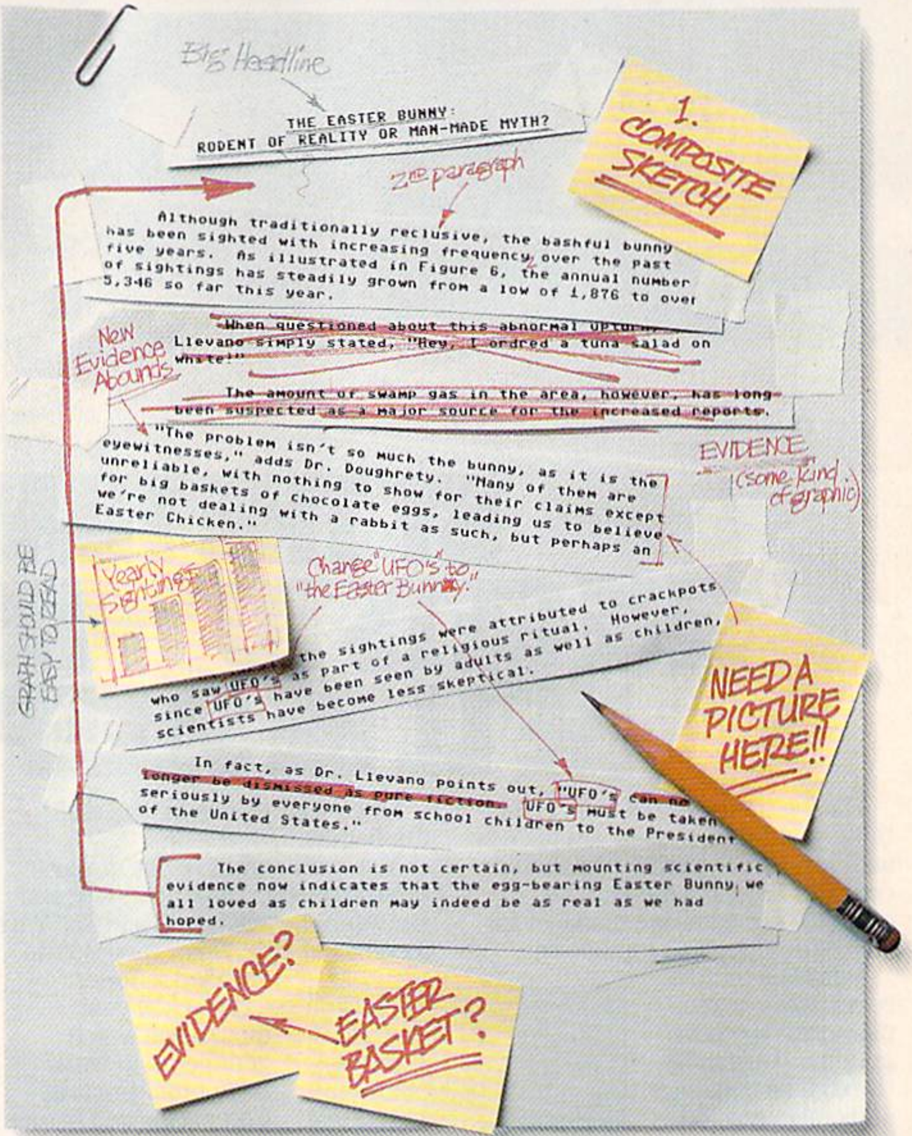
Vicki Hayden

When you create an array using DIM, numeric arrays are initialized to zeros, and string arrays are initialized to null strings. A null string contains no characters; it's a string full of nothing. If you open a sequential file and write a null string to it, you're writing nothing at all to the file. A PRINT# statement generally adds a carriage return—CHR$(13)—after each string or number, so if you examine the contents of the file, you'll see a CHR$(13) only.

We experimented a bit with sequential files and discovered that INPUT# doesn't like null strings. For example, if you PRINT# "ABC" followed by a null string and then "DEF", and read through the characters (with GET#), you'll see 65, 66, 67, 13, 13, 68, 69, 70, 13—three ASCII characters for ABC, a 13, nothing for the null string, another 13, then three ASCII characters for DEF, followed by a carriage return.

If you INPUT# from the file, you'll receive an ABC and a DEF, but no null string. This is true in both 64 and 128 modes.

THE STRON[G]
ARE BUILT WIT[H]



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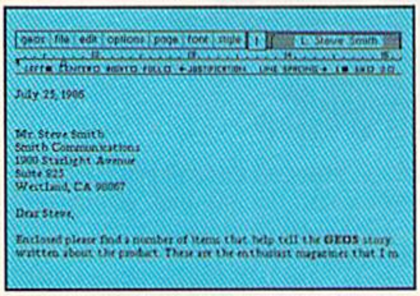

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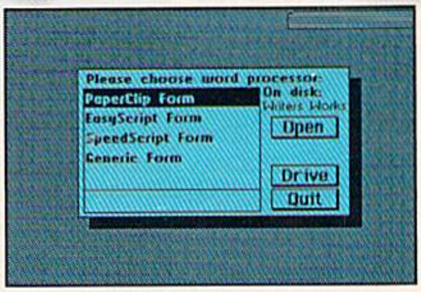
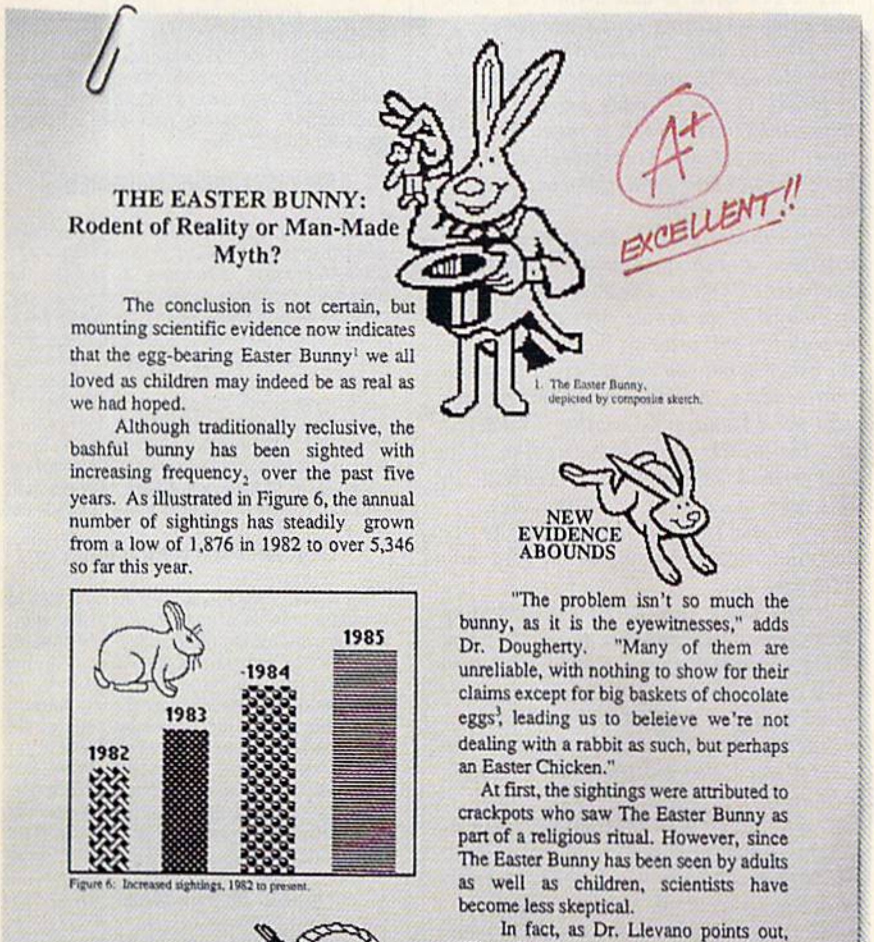


GEST CASES
H A WORKSHOP.



A+
EXCELLENT!!

THE EASTER BUNNY: Rodent of Reality or Man-Made Myth?

The conclusion is not certain, but mounting scientific evidence now indicates that the egg-bearing Easter Bunny[1] we all loved as children may indeed be as real as we had hoped.

Although traditionally reclusive, the bashful bunny has been sighted with increasing frequency[2] over the past five years. As illustrated in Figure 6, the annual number of sightings has steadily grown from a low of 1,876 in 1982 to over 5,346 so far this year.

Figure 6: Increased sightings, 1982 to present.

1. The Easter Bunny, depicted by composite sketch.

NEW EVIDENCE ABOUNDS

"The problem isn't so much the bunny, as it is the eyewitnesses," adds Dr. Dougherty. "Many of them are unreliable, with nothing to show for their claims except for big baskets of chocolate eggs[3], leading us to beleieve we're not dealing with a rabbit as such, but perhaps an Easter Chicken."

At first, the sightings were attributed to crackpots who saw The Easter Bunny as part of a religious ritual. However, since The Easter Bunny has been seen by adults as well as children, scientists have become less skeptical.

In fact, as Dr. Llevano points out, "The Easter Bunny must be taken seriously by everyone from school children to the President of the United States."

Figure 4: Evidence submitted by Dr. Dougherty.

text, replacing worn-out words and phrases with your brand new ones.

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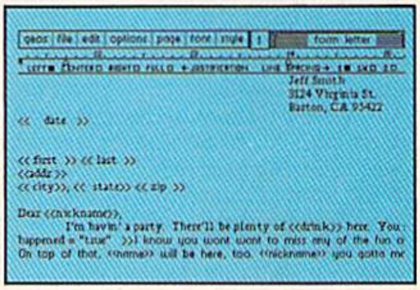

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Berkeley Softworks

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A couple of solutions are available. The first is to avoid writing a null string if you're going to use INPUT# to read the file. Instead, send some character to indicate a null entry. INPUT and INPUT# ignore leading spaces, so don't send a space. You should be able to use any other character—including a shifted space, CHR$ (160). The second is to avoid using INPUT#. If you use GET# to retrieve one character at a time, you can concatenate the string until a CHR$(13) is encountered.

It's difficult to say what the problem with IMP.COM is. There has been some talk on telecommunications services that an early version of that program worked only with 1200-baud modems, which could be one source of difficulty. Another possibility is that the program dials with Hayes-type commands (ATDT or ATDP). If this is the case, you'll have to dial the number yourself instead of relying on the program to dial.

There's another terminal program for CP/M mode called MEX.COM. It does work with 300-baud modems, but before you begin, you have to type SSET 1650 or SSET 1660, because the version we've seen defaults to the 1200-baud 1670 modem. You may have to use an overlay for IMP or a command that sets the speed to 300 baud.

Who's In Charge Here?

I have a 64, a 1541 disk drive, an Epson RX-80 printer, and a Turboprint/GT interface. In using the *Homeword* software, my son wrote a multipage report with top, bottom, and side borders defined according to the *Homeword* instructions. When the report was printed, the first page was OK, but each succeeding page went beyond the bottom border and crossed over the page serrations.

When I initially set up the printer and interface, I set the DIP switches by the instructions. I did find that I had to set switch 2-3 in the printer to Off to prevent double-spacing because the computer controls the linefeed. The test program built into the printer worked perfectly across multipage prints, recognizing the end of the page and going to the next page.

Is the software at fault? Is it the interface? Or did my son program the borders incorrectly?

K.J. Haltiner

There are a couple of solutions to your problem. But first here's an explanation which applies to printers and interfaces in general.

When the printer finishes printing a line, two things need to happen: The printhead should move to the beginning of the line, and the paper should advance one line. Traditionally, a carriage return (CR) only moves the printhead to the beginning of the line it's on. It can thus be used to print a line and go back to the beginning to underline or overstrike various characters that are already printed. A separate linefeed (LF) character causes the paper to move up a line. The ASCII codes for CR and LF are CHR$(13) and CHR$(10), respectively.

Commodore printers and screens use only a CR at the end of a line. In this case, CHR$(13) means move to the beginning of a line and move to the next line. It also means you need to add a linefeed when you print something to the printer.

The printer, the interface, and the computer are all programmable. There are a variety of ASCII codes you can use to send commands to each of them. In addition, printers and interfaces generally have rows of DIP switches you can set to create various effects.

All three devices—the computer, the interface, and the printer—are capable of adding the linefeed. The question is, who's in charge? If no device adds a CHR$(10), everything will print on the same line. On the other hand, you could have a program that sends a 13 plus a 10. The interface sees the 13 and adds another CHR$(10), and the printer says to itself, "Aha, a 13 just arrived. I'd better add a linefeed." In this case, you'd have triple spacing.

It doesn't really matter which device adds the linefeed, as long as one (and only one) does so.

The same idea applies to skipping over the perforation at the end of the page. You've indicated that the printer is set to skip over the perforation. The printer keeps a tally of how many lines have been printed so far. When the page is nearly full, it skips ahead a few lines to start a new page.

The problem is that your word processing program is doing the same thing. When it approaches the bottom of a page, it sends some blank lines. In the meantime, the printer has also decided to move to the next page and, when it gets there, starts printing the blank lines the computer has sent.

You'll have to decide who's in charge of skipping over the perforation between pages. If it's the printer, then set the word processing program to have no margin at the top or bottom. If the word processor controls the margins, then you'll have to turn off the automatic paging feature of the printer.

ARE YOU SEARCHING FOR FRIENDS?

If you're finding it increasingly difficult to find anything at all, maybe it's time you found out about geoDex. The GEOS-compatible directory that generates mailing lists. Prints address labels. And sorts out all sorts of things for your Commodore.

Try directory assistance. With a little help from geoDex, you can call up a directory organized from any three categories you choose. Which means you can list your friends by name, telephone number or almost anything else that can be assigned its own three-character code.

Like "MEN" for guys you know. Or "GRL" for girls you know. Or "FOX" for girls or guys you'd like to know.

But no matter how you choose to categorize them, if you can point and click a mouse, you can call up any list of friends with geoDex's easy-to-read graphics.

Our most inviting feature. Of course, once you've gotten your friends organized, the next thing we recommend you do with geoDex is really very simple.

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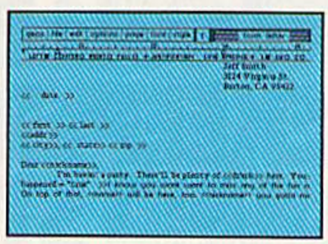
You see, geoDex comes with geoMerge, a mail merge program that customizes form letters, announcements —even party invitations—with the names and addresses stored in geoDex. First you write the letter with geoWrite. Then you select a list from geoDex.



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User Group Update

When writing to a user group for information, please remember to enclose a self-addressed envelope with postage that is appropriate for the country to which you're writing.

Send typed additions, corrections, and deletions for this list to:

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Greensboro, NC 27403
Attn: Commodore User Groups

User Group Notes

The correct address for the **Edison Commodore User Group (ECUG)** is Code 8103, U.S. Naval Research Laboratory, Washington, D. C. 20375–5000.

The **Akron Area Commodore Users Group (AACUG)** has changed its address to P.O. Box 685, Akron, OH 44309.

The **American MIDI Users Group (AMUG)** provides information about the MIDI and using computers to produce music. The group operates a BBS network called MidiNet. Affiliate chapters will be set up around the country so members can hold regular meetings. Membership is free for Level 1 members, $20 for Level 2, and $75 per year for Level 3. For more information, write to **American MIDI Users Group**, 7225 Fair Oaks, Ste. 515, Dallas, TX 75231.

Ministers' Users Group (MUG) is for any 64 user who ministers to others in a church/synagogue context or is a church/synagogue worker. The purpose is to compile and exchange information and programs that can be used in religious work. The group is open to people of all faiths who are involved in religious education and ministry. The mailing address is **MUG**, 9 Lamport St., Vittoria, Ont., Canada N0E 1WO.

New Listings

ARKANSAS

Commodore 64/128 Users Group, P.O. Box 2481, Hot Springs, AR 71914

CALIFORNIA

Cantell Commodore 64/128/CPM Mail Users Group (CMUG), c/o Cantell Computer Services, 3119 Isabel Dr., Los Angeles, CA 90065

COLORADO

First United Nocturnal Golden Users' Service (FUNGUS), 1869 West Campus Rd., Golden, CO 80401

INDIANA

QS! Alliance (QS/INKY), P.O. Box 1403, New Albany, IN 47150

IOWA

Fort Dodge Commodore Users Group, 1606 Second Ave. North, Fort Dodge, IA 50501

KENTUCKY

Christian County Commodore Computer Club (CCCCC), 1611 S. Main St., Hopkinsville, KY 42240

Purchase C64 User's Group, Rt. 1, Box 209A, Calvert City, KY 42029

MONTANA

Commodore Classic User Group, P.O. Box 3454, Great Falls, MT 59403

PENNSYLVANIA

W-B Commodore Users Group, 249 S. Hancock St., Wilkes-Barre, PA 18702

WASHINGTON

64/128 Commodore Users Exchange, P.O. Box 1801, Walla Walla, WA 99362

WISCONSIN

Price County Computer User Group, Rt. 2, Box 532, Phillips, WI 54555

Outside the U.S.

APO

Giebelstadt Commodore Users Group (GCUG), SFC Willie R. Obie, P.O. Box 154, APO, NY 09182

AUSTRALIA

Melbourne Commodore Computer Club Inc., P.O. Box 177, Box Hill, Victoria, 3128, Australia

CANADA

Port Coquitlam Computer Club, 1752 Renton Way, Port Coquitlam, B.C., Canada V3B 2R7

COLOMBIA

Columbia C-64 Users Group, Pedro Allima & Hernan Zajec, A.A. 81119, Bogota, Colombia

Kathy Yakal
Assistant Features Editor

The Commodore GRAPHICS Connection

It was first conceived as primarily a computerized game system, with flashy color graphics and multivoice sound. So it's not surprising that the Commodore 64's remarkably sophisticated and versatile graphics still stack up well even against the new 68000-based computers. With the right software, the 64 is an inexpensive graphics tool that's surprising in its flexibility and power.

The Commodore 64's introduction at the Consumer Electronics Show in January 1982 created a sensation because of the machine's exceptional color graphics, advanced sound and music chips, and relatively low price (about $600 at that time). No one had yet put together such a package in the emerging microcomputer field.

Competing against the popularity of both video arcade games and the video cartridge system (VCS) game markets, the Commodore 64 was itself a hybrid system that started out to be a videogame machine even before it was turned into a computer. For almost a year, engineers at MOS Technology had been developing two remarkable custom chips: the VIC II graphics chip and the SID (Sound Interface Device) chip. When they began, the idea was to create custom chips that could form the foundation of a first-rate videogame machine, not a personal computer.

But, happily, Commodore chief Jack Tramiel changed his mind, and headed the chips toward what would soon become the Commodore 64. Dozens of game titles were soon developed for it, there were some original designs, and some programs were ported over from the Atari 800 computer, another graphically advanced micro. Other applications were also created for it, making it a good home productivity and educational tool. But it was the abundance of graphically superior games that helped to spur sales tremendously.

More than five million Commodore 64s have been sold now, and much of the reason still centers on the graphics capabilities and the uses to which those features have been put by software developers.

First, it's a superb game machine, and games still sell home computers. Second, many artists and would-be artists have found the 64 to be an innovative and exciting drawing and painting tool, thanks to the many graphics packages that have been introduced over the years. And finally, the Commodore 64—at less than $200—can be outfitted to function as a graphics workstation for sophisticated applications that usually require equipment costing many thousands of dollars.

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Better Graphics Means Better Games

Only with the introduction of such 16-bit personal computers as the Atari ST and Commodore Amiga have we seen better color graphics for widespread consumer and business use. In fact, for the price, the Commodore 64 is still in many ways the machine to beat.

But it's taken game designers several years to become very proficient at using all of the Commodore 64's graphics powers, and for a number of reasons.

First, familiarity with the machine's capabilities took time and much effort. Whenever a new computer is introduced, it takes a while for potential superstar developers and development teams to learn the machine inside and out, allowing them to create the best possible graphics. The learning curve varies from computer to computer, depending on how thorough the programmers' documentation is, how many upgrade stages a chip goes through before there's a "final" version, and the accessibility of high-level programming languages. In most cases, as with the 64, software developers over time learn to create effects with particular computers that the original designers never envisioned.

Market pressure may also have played a part in the learning curve. The Commodore 64 was introduced at an extremely volatile time in the history of microcomputers. The heat was on everyone to get software out en masse as fast as possible to take advantage of the enormous increase in the number of computer users. Instead of learning slowly and carefully, program designers were often required to rush products out the door as soon as possible to beat the competition. That meant less time for careful study and stretching of the machine's capabilities.

That same market pressure forced some companies to quickly convert their software programs into Commodore format from other computer versions. But what looked best on one computer didn't necessarily take advantage of the 64's features. Once designers started focusing their attention on the Commodore 64, many found it to be an excellent game environment with a great deal of untapped potential.

Though the Flexidraw Light Pen System is marketed primarily for business applications, it is one of the remaining light pens available for consumer use. Colorful pictures like the one shown here can be created by first designing a high-resolution black-and-white drawing and then adding color where necessary.

...for the price, the Commodore 64 is still in many ways the machine to beat.

Input from graphic artists on software design teams has also contributed to better graphics in games. The team approach itself has made a marked difference in the quality of the finished software in many cases, since it's a rather unusual individual who embodies all of the widely varied skills necessary to develop a challenging, visually appealing computer game. Artists helped tremendously in improving the overall look of a game.

Making Graphics Accessible

In the early days following the introduction of the 64, the only way to make a picture appear on the screen was by knowing a programming language well enough to manipulate colors and graphics. Except for professional programmers, few people cared to take the time to overcome these obstacles. The average consumer couldn't use the computer as a drawing tool.

However, some software publishers began introducing simple drawing and painting programs. Often using joystick-driven menus, these programs allowed users to select from a variety of shapes, lines, colors, and fill patterns to produce their own drawings. (See "A Buyer's Guide to Commodore Graphics Programs" elsewhere in this issue.)

To make this process easier, a few companies introduced consum-

er versions of graphics input devices that had previously been used for more sophisticated professional applications. Light pens, for example—touch-sensitive hand-held pens that can manipulate objects on the screen through contact with the front of the monitor—became available, along with graphics tablets—square- or rectangular-shaped drawing tablets (connected by a cable to the computer) that let the user make screen drawings by drawing on the face of the tablet. These alternatives to the keyboard and to joysticks were often packaged with compatible paint programs.

Firebird Licensees, U.S. distributor for award-winning European software like Elite, *has introduced a Commodore version of* The Pawn. *Superb graphics and depth of play are making Firebird games successful in the U.S., too.*

Although these devices have never achieved the popularity that was originally anticipated, the advanced versions continue to be used by many software developers as well as professionals in other fields for more sophisticated design work.

Sophisticated Applications

Why these input devices never caught on in a big way with consumers may be traced to a number of factors. "It wasn't the light pen as far as the concept of data entry," says Sherry Kuzara, president of Inkwell Systems. "It was the quality of what they were putting out there. Depending on what kind of monitor the consumer was using, it may or may not have worked properly. Plus, because the light pens weren't sophisticated, the software had to be slow so the pen could keep up with it."

Kuzara, who has been involved in the field of electronics for the last 20 years, started Inkwell Systems in 1983 with the Flexidraw Light Pen, developed for use with the Commodore 64. Setting the pen's initial price at $149.95 made it difficult for her to get the product carried by mass merchandisers or distributors, since the price of the 64 itself at that time was only a hundred dollars or so more than that.

"So we said we have a choice," says Kuzara. "Either sell millions of these things and put in a cheap light pen, or we'll have a smaller share of the market but put out a quality product with a quality instrument. We chose the latter. So the quality of the instrument is very, very good. It wasn't a toy."

Kuzara's choice was evidently the right one. Inkwell Systems is still in business, and the Flexidraw Light Pen has a respectable presence in several large industries.

Many of the game designers at Accolade Software have been stretching the graphics capabilities of videogames since the old Atari VCS days. Here is a screen from the recent Commodore 64 release, Deceptor.

Companies such as GE Weapons and GE Plastics, Rockwell, Northrup, and Hughes have sent engineers to Inkwell's office in San Diego for demonstrations because they needed something for circuit design that was inexpensive but would give them hardcopy. After seeing the precision work the pen can do, many of these companies have purchased Commodore 64s and digitizing systems and plotters for their high-level design work.

A New Face For An Old Friend

The introduction of the Apple Macintosh in 1984, with its mouse, icons, and menu-driven user interface, established a new look for personal computers that also made it simpler for users to execute commands and move around within the system. Later, the Commodore Amiga and Atari ST followed suit with similar interfaces, and that met with consumer approval.

Not to be outdone in the new graphics-oriented desktop environment, designers at Berkeley Softworks premiered a similar user interface in 1986 as a part of its *GEOS* operating system for the Commodore 64. *GEOS* (Graphic Environment Operating System) is loaded into the 64 from disk, replacing the normal 64 operating system with a *desktop* environment, an opening screen with icons and a command bar with drop-down menus. Besides speeding up disk functions and offering a simple joystick- or mouse-driven command screen, *GEOS* includes two personal productivity utilities: *geoPaint*, a paint program, and *geoWrite*, a word processor. There are also a variety of optional software products that work within the *GEOS* environment.

geoPaint functions much like other color drawing programs, allowing you to "pick up" brush widths, shapes, lines, and fill patterns to create very precise drawings. Within that program itself, there's a mini-word processor that lets you enter text directly onto a document, similar to programs like *The Print Shop* and *The Newsroom*.

"The whole idea of being able to produce a document with both text and graphics is, of course, very useful in the home," says Jim De Frisco, Senior Project Engineer at Berkeley Softworks and one of *geoPaint*'s designers. "It's very good for just general correspondence between friends and for newsletters for people who are involved in different community organizations."

De Frisco says that school reports are another application for *geoPaint* documents. "I remember doing reports in school and pasting together hand-drawn pictures," says De Frisco. "The whole idea of being able to make your reports and

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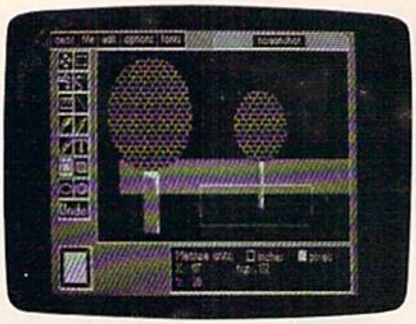
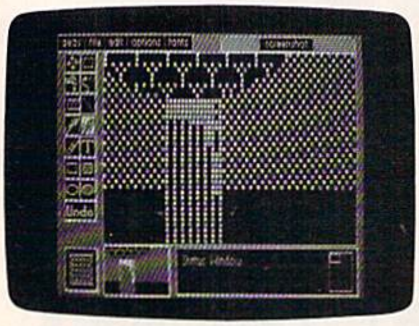


The geoPaint *drawing environment. Tool icons are at the left of the working area. The tool being used to draw the white rectangle displays precise measurements at the bottom of the screen.*



geoPaint's *pixel edit option enables the artist to magnify any section of a design for precise detail work. Note the small status window (lower right) which indicates the working area's position in the document.*

other schoolwork that much nicer-looking gives students more pride in their work."

A Similar System For Hundreds Less

GEOS comes bundled with the new Commodore 64C computer, or can be purchased separately for $59.95. At that price, you wouldn't expect it to offer the same speed and capabilities as those systems costing ten times more.

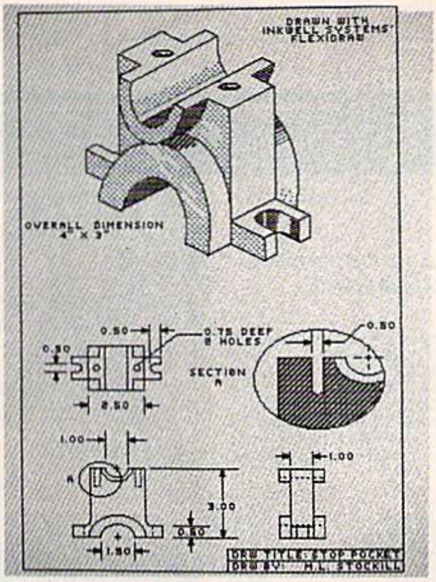
But De Frisco and his team of engineers encountered less trouble than might have been expected, given the limited memory of the Commodore 64. "As far as the Commodore product itself, the microprocessor is pretty well suited for this type of application, because it can very efficiently move information around within the memory of the computer," he says. "Even though it runs at a lower clock speed and is so much less expensive than some of the other machines that are available, when you actually sit down and figure out how long it takes to move information around the computer, it's not that much slower than some of the other machines out there. Through a number of optimizations—looking at the capabilities of the microprocessor—we were able to get reasonable performance out of the machine where it hadn't really been gotten before."

For the paint documents, the *GEOS* design team wanted to maintain as great a resolution as possible. So they used the high-resolution graphics mode available on the Commodore, which doesn't allow you to specify one color for each pixel on the screen, but specifies color for every 8 × 8–pixel grid.

Another problem with creating graphics on the Commodore 64 is the memory limitation. On the Macintosh, for instance, you have half a megabyte, a megabyte, or more, to use for data and program space. On the 64, you have at most 64K. So the design team spent a lot of time compacting the code and making it more efficient, often developing fairly exotic representations for the data. Memory continues to be a problem with some of the more intricate *GEOS* applications currently under development. But De Frisco is looking to the RAM-expansion cartridge planned for the 64 by Commodore as one of the biggest performance boosts for the machine.

Printing out high-resolution graphics is another problem. Inexpensive dot-matrix printers are capable of printing rather rough graphic representations, not like some of the crisp drawings that can be viewed on the screen. As one solution, documents created using *GEOS* can be uploaded through QuantumLink, the Commodore-specific online news and information network; printed on a laser writer at Berkeley Softworks; and then mailed back to the user.

Does De Frisco think the graphics capabilities of the 64 have been stretched to the limit by the development of such tools as *GEOS*? "I'd say so. We've pored over our code many times trying to find ways to optimize the way it works," he says. "The Commodore has set video modes, and as far as



Using the Commodore 64 with a Flexidraw Light Pen from Inkwell Systems, many professionals are getting results similar to those previously obtainable only from expensive high-end graphics workstations.

the quality on the screen, it can only be as good as the video modes allow you. The parameters for that include the resolution and color capability of the different modes. As I said, we chose the highest resolution mode, so I think the quality of the images on the screen in the different *GEOS* programs is as high as it could be."

Five years ago, the designers of the Commodore 64 could scarcely have envisioned a graphics-based system such as *GEOS* being used on their newborn computer. In fact, many of the computer games, paint programs, and design packages that have emerged over the last year or so for the 64 have established new standards of excellence for the machine. And, for now, there seems to be no reason to assume those advances will stop.

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We can go on and on about the flexibility, features and challenges these exciting games have to offer. But when we said "forever" in the headline, we meant playing, not reading! To find the closest thing to eternal happiness in wargaming, check out these two games at your local computer/software or game store today!

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A Buyer's Guide To Commodore Graphics Programs

The Commodore 64 has never lacked for programs that take advantage of the computer's graphics power and versatility. Listed below is a brief buyer's guide to a variety of paint, animation, design, drawing, and specialized print programs for the 64.

Blazing Paddles

Baudville
1001 Medical Park Dr., SE
Grand Rapids, MI 49506
$34.95
A drawing and painting program that lets you mix colors to create over 200 textured hues. Includes airbrushing, ovals, lines, a zoom feature, editing with pixels, and a variety of brushes, text fonts, and predrawn shapes.

Cadpak-64 or *-128*

Abacus Software
P.O. Box 7219
Grand Rapids, MI 49510
$39.95 (64 version)
$59.95 (128 version)
A computer-aided design (CAD) package for creating high-resolution pictures and graphic designs. Draw and edit pictures, drawings, or layouts. Other features include dimensioning, zoom, color-fill, and printout capabilities.

Certificate Maker

Springboard Software
7808 Creekridge Circle
Minneapolis, MN 55435
$49.95
A design and printing program that lets you create more than 200 awards and certificates for schools, clubs, businesses, and other uses. Certificates can be personalized, designed, and printed out. A variety of stickers are included.

Chartpak-64 or *-128*

Abacus Software
P.O. Box 7219
Grand Rapids, MI 49510
$39.95
A drawing program with which to design, draw, edit, and print pie, bar, and line charts or scatter graphs. It also calculates and inserts statistics such as the mean, regression, and least squares into the charts.

ColorMe: The Computer Coloring Kit

Mindscape
3444 Dundee Rd.
Northbrook, IL 60062
$29.95
$9.95 (optional picture disks)
$9.95 (ColorMe Supply Box)
This introductory drawing package lets children ages four and up practice freehand drawing and coloring, or cutting and pasting predrawn pictures. Text can be added, and the finished product can be printed out. Optional picture disks feature *Rainbow Brite, Shirt Tales, Tink! Tonk!*, and *Hugga Bunch*. The *ColorMe* Supply Box contains buttons, colored printing paper, and adhesive-backed paper for making stickers.

Desk Pack I

Berkeley Softworks
2150 Shattuck Ave.
Berkeley, CA 94704
$34.95
The *Graphics Grabber* portion of this desktop utility package copies graphics from clip-art galleries like *Print Shop, Print Master*, and *Newsroom* for use with *geoWrite* and *geoPaint* (from *GEOS*).

Doodle

Crystal Rose Software
109 S. Los Robles
Pasadena, CA 91101
$39.95
A color drawing program for the Commodore 64 that works in true high resolution.

Flexidraw Light Pen Graphics, Version 5

Inkwell Systems
P.O. Box 8152 MB 290
7677 Ronson Rd. #210
San Diego, CA 92138
$149.95; upgrade $12.95
An advanced graphics and light-pen package that includes shapes, fonts, and drawing enhancements.

Flexifont

Inkwell Systems
P.O. Box 8152 MB 290
7677 Ronson Rd. #210
San Diego, CA 92138
$29.95
A font- and character-generating package to use with the Flexidraw Light Pen that contains 33 letter styles and has custom lettering and editing capabilities.

Fontpak I

Berkeley Softworks
2150 Shattuck Ave.
Berkeley, CA 94704
$29.95
Twenty fonts to incorporate into documents created using *GEOS* for the Commodore 64.

geoPaint

Berkeley Softworks
2150 Shattuck Ave.
Berkeley, CA 94704
$59.95 (for GEOS)
A full-featured, advanced color drawing and painting program that is part of the total *GEOS* package.

Graphics Expander, Volume 1

Springboard Software
7808 Creekridge Circle
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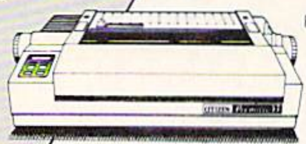

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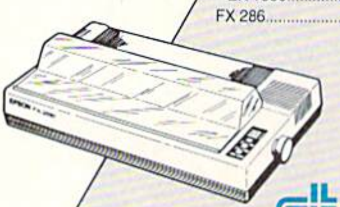

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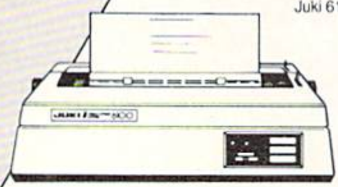

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simple answers to common questions

Tom R. Halfhill, Staff Editor

Each month, COMPUTE!'s GAZETTE *tackles some questions commonly asked by Commodore users. If you have a question you'd like to see answered here, send it to this column, c/o* COMPUTE!'s GAZETTE, *P.O. Box 5406, Greensboro, NC 27403.*

Q. I recently acquired an Apple Unidisk drive and am wondering if anyone makes an interface to connect it to my Commodore 64. Are they compatible? Is it possible for me to make my own interface? I would love to use the Unidisk as a second drive.

A. To our knowledge, no one makes an interface to connect a 3½-inch Apple Unidisk drive to a Commodore 64. Building one yourself would be such a formidable electronics project that we think you'd be better off buying a 1541 or 1571 as a second drive. You could probably connect the Unidisk to your 64 via the Spartan Apple emulator made by Mimic Systems, but this would cost you several times as much as a second 1541 or 1571.

We receive many letters every month from readers who want to hook up all kinds of incompatible peripherals and accessories to their computers. In general, it's safe to assume that such shotgun marriages aren't possible or practical unless the devices to be joined have industry-standard interfaces—such as an RS-232 serial port or Centronics parallel port.

Q. What knocks a disk drive out of alignment? Can you fix it yourself? If so, how?

A. The most critical mechanical part of a disk drive is its *read/write head.* This is quite similar to the record/play head of a tape recorder. When the computer is writing data to the disk, the read/write head exerts magnetic force on the metal oxide surface of the floppy disk to realign the particles into a pattern of binary 1's and 0's. When the computer is reading data from a disk, the read/write head scans the particles so the computer can interpret it.

The magnetized patterns on the disk are laid out in concentric rings called *tracks* (unlike a vinyl record, which has one continuous, spiral ring). These tracks, in turn, are divided into arc-shaped segments called *sectors.* To access the tracks and sectors, the read/write head slides along a guide rail under the control of a very precise stepper motor. Because the tracks and sectors are laid out very close together, proper alignment of the read/write head on the guide rail is critical. If the head becomes misaligned, it may not be able to read the tracks at the extreme inner and outer edges of the disk, or it may confuse one track with another.

Read/write heads can be misaligned for several reasons: faulty assembly at the factory; hard knocks during shipment to the dealer; vibration (which is why computers installed in factories are shock-mounted); bumps and jolts inflicted while moving the drive from place to place (computer systems carted around to monthly user group meetings are prone to this); and wear and tear due to heavy use. In addition, some copy-protection schemes used by commercial programs force the read/write head through some noisy acrobatics, which may accelerate wear.

A typical symptom of misalignment is when the drive balks at reading from or writing to certain disks. It might be a disk that you've used for months—then suddenly it becomes unreadable. Yet, the drive may have no trouble working with recently formatted disks, since the tracks were laid out while the read/write head was in its new (misaligned) position.

Adjusting a read/write head is a touchy job that is best left to a qualified technician. However, there are kits and alignment programs available if you want to tackle the job yourself. You can find them advertised from time to time in COMPUTE!'s GAZETTE and other magazines. (In the October 1984 issue, we reviewed *1541 Disk Drive Alignment* from CSM Software, a very popular package).

Q. With respect to possible damage, is there any difference between physically plugging or unplugging a cartridge on the expansion port of a computer while the computer is turned on, and electrically switching on or off the same cartridge mounted on an expansion board? I can see that in the first case, contact is made or broken between the mating portions of the components involved, while in the second case physical contact already exists and electrical contact is made or broken.

A. Switching off a cartridge on an expansion board is a safe way of electronically "unplugging" it from the computer. In fact, that's one of the advantages of multislot expansion boards, in addition to their convenience and the wear they save on the computer's expansion slot.

Physically plugging or unplugging a cartridge while the computer is turned on, however, is definitely risky. If you don't align the cartridge perfectly with the connector, you could short-circuit the cartridge and computer. If you're lucky, you'll just blow a fuse, but there's also a risk of damaging the delicate electronic innards of the cartridge and computer. It's a good practice to always turn off a computer before plugging or unplugging any kind of external device.

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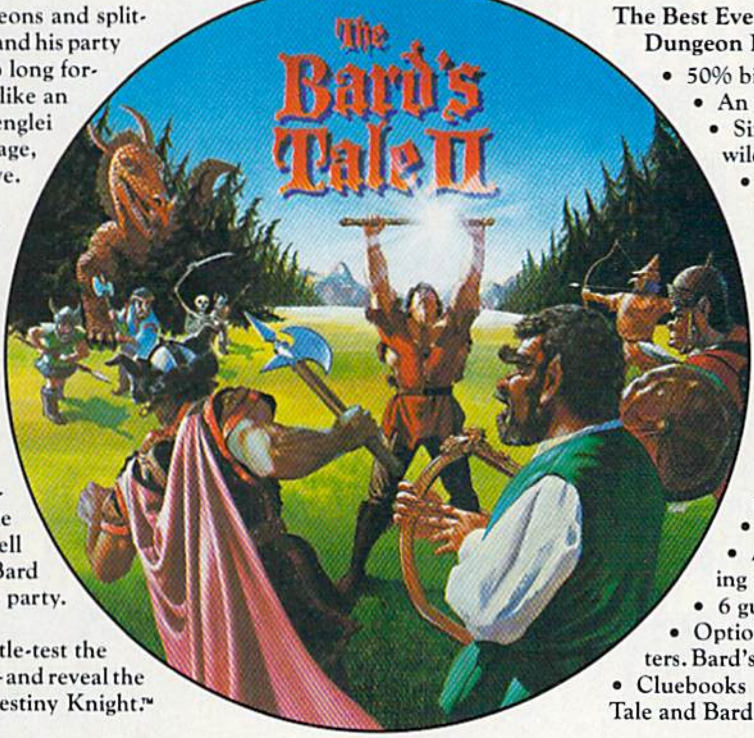

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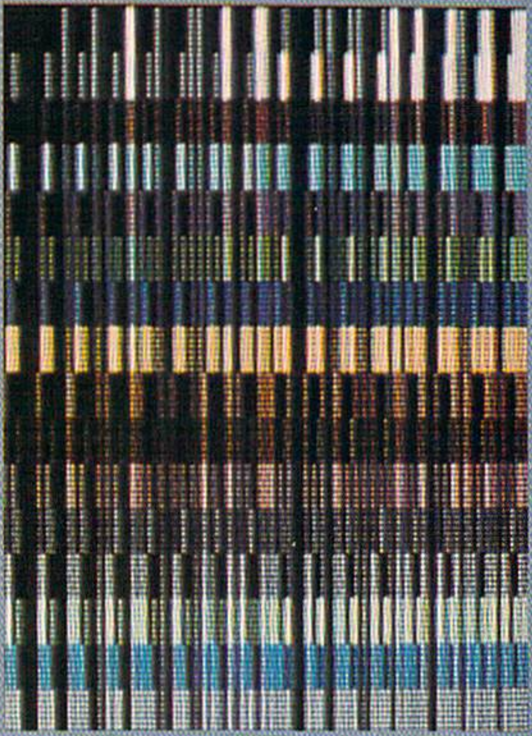


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The Fundamentals Of Commodore 64 Graphics

Lee Noel, Jr., Assistant Editor, Art and Design

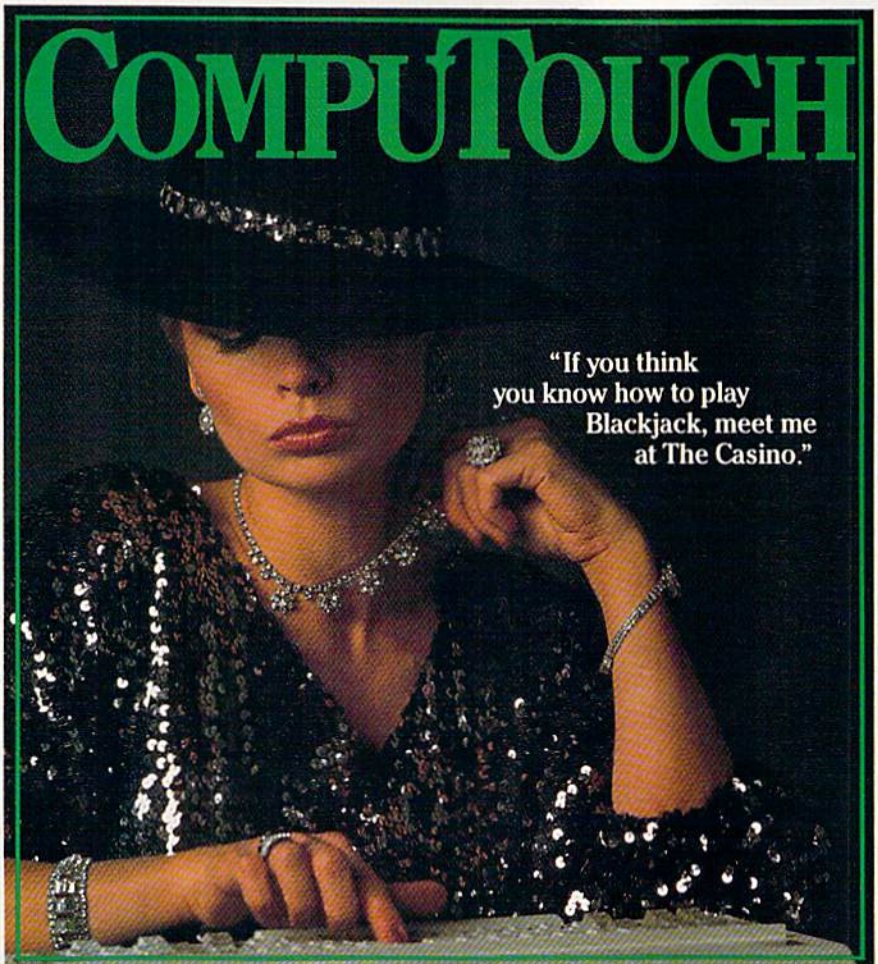
The Commodore 64's impressive graphics capabilities are the result of the computer's remarkable, but initially bewildering, array of graphics modes and features. For a better appreciation of the 64's screen magic, here's a gentle hands-on introduction to the fascinating world of Commodore 64 graphics.

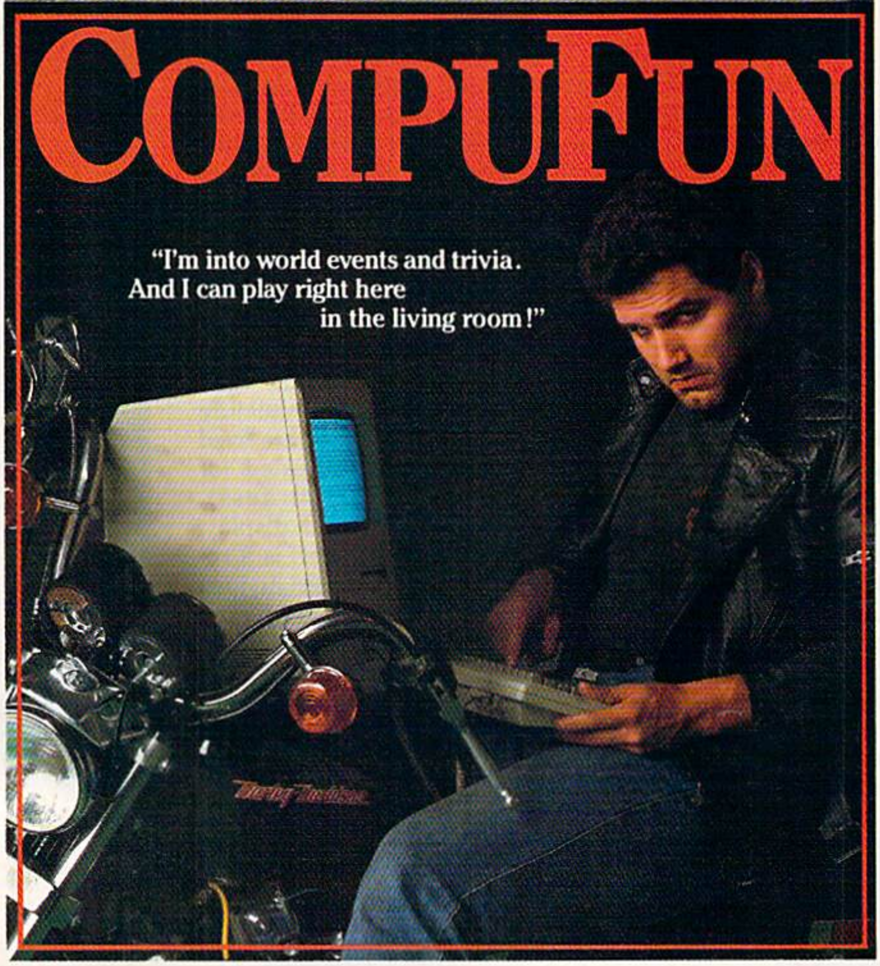
Five years have passed since the Commodore 64 was first introduced. The machine, which has since become the bestselling personal computer in the world, continues to sell well in its new incarnation as the 64C. And, of course, there's also a complete 64 inside every Commodore 128.

The 64's great popularity is based, in part, on the high quality of its graphics. Even today's powerhouse machines—Commodore's own Amiga, Atari's ST, and Apple's IIGS—offer graphics capabilities that are not really very far removed from those of the 64. As far as graphics go, the 64 has been a tough act to follow. Let's take a close-up look at the 64's formidable graphics capabilities, and examine the various graphics modes. The hands-on examples included in this article will display all the modes and provide demonstrations of some of the principles of Commodore 64 graphics operations. Bear in mind, however, that even a nontechnical discussion of graphics must use some computer terminology. But we'll make every effort to introduce it only when necessary, and only as an aid to clarity.

Miniature Lightbulbs

A close look at any 64 screen display reveals an image made up of thousands of tiny dots of light. These dots are called *pixels*—short for *picture elements*—and they can be thought of as miniature lightbulbs. Although the bulbs are fixed in position, they can be adjusted for color and intensity (brightness). Everything you see in a screen display, including apparent movement, is a result of these adjustments. To get an idea of how they work in practice, try typing in the following brief program. (To insure that the program will work properly, type it in exactly as it's printed. Watch carefully for semicolons. They often immediately precede colons, as in lines 10, 30, and 40.)






```
10 POKE53280,0:POKE53281,2:R=2
   4:CM=55296:W=40:PRINT CHR$(
   147);:FOR C=1 TO 6
20 POKE 646,(-(C>0)*6-(C>1)*8+
   (C>2)*13-(C>3)*6-(C>4)*6+(C
   >5)*8)
30 FOR B=1 TO 160:PRINT CHR$(1
   66);:NEXT B:NEXT C:POKE 646
   ,9
40 FOR I=2 TO W:PRINT CHR$(115
   );:NEXT I
50 FOR I=0 TO W:POKE CM+W*R+I+
   (I>39),7:POKE CM+W*R+I+(I>1
   ),9
60 FOR T=1 TO W:NEXT T:NEXT I:
   GOTO 50
```

When run, the program creates a number of horizontal bands of color. Each of these bands is made of a pattern of small, uniformly sized blocks. In turn, each of these blocks is made up of four pixels. This structure is seen more clearly in some colors than in others, but if you look closely, you'll see that the entire screen is built up of the tiny pixels—all identical in size and all fixed in place.

In most areas, the color differences between pixels are obvious. Also, in the greenish bands, for example, you'll see two greens of different intensity. Even at the bottom of the screen, where a heart shape is apparently moving rapidly across the display, close observation will reveal that the pixels are not moving at all. Only the way they are lit and colored is changing. As you can see, changes in intensity and color are the key to the entire display.

The effect is similar to the sort of moving patterns seen in the lighted advertisements often used on blimps. In this case, however, each pixel is capable of displaying any of the 64's 16 colors. (To break out of the program, hold down the RUN/STOP key and press the RESTORE key sharply.)

Resolution And Graphics Modes

The size of the pixels is of great importance to the general appearance of the display. Imagine a screen with 100 pixels arranged in a 10 × 10 grid. Graphics displayed on such a screen would have to be large and blocky. If, instead, we imagine that the same screen is 20 × 20, with 400 pixels, we can expect smaller blocks and a more detailed display. In general, the smaller the pixels, the finer the image. The degree of fineness of a display is known as *resolution*. For computer screens, resolution is usually described in terms of the number of pixels making up the screen, expressed as width times height (for example, 320 × 200).

Thus, our two imaginary screens would be described as having resolutions of 10 × 10 and 20 × 20. The 20 × 20 screen, with a higher number of pixels, is said to have a higher resolution than the 10 × 10 screen. The 64's resolution is considerably higher than that of either of the imaginary examples. In fact, the computer's maximum resolution is 320 × 200, for a total of 64,000 pixels. Interestingly, this is also the most frequently used resolution for color displays on the Amiga and ST. The 64 also offers a low-resolution screen of 160 × 200 pixels. This setup provides more color possibilities than the other, but it also doubles the width of the pixels, making displays more colorful, but coarser.

We've just discovered two different screen-resolution arrangements for the 64. These and other variations in displays are known as graphics *modes*, and the 64 offers five pairs of them.

Standard Character Modes

Let's look at the various modes to see how they're used and to determine the different kinds of graphics displays that can be constructed with them.

The first mode is known as *standard character mode*. This is the normal text mode that you see when you turn on the machine and type something. Characteristics of this mode are one overall background screen color and the display of letters and numbers, each of which may have only one of the 64's 16 colors. Also available are a large number of predefined graphics shapes which can be accessed instantly by just typing on the keyboard. The heart shape in the demo program is an example of one of these graphics.

Before further discussion, it's important that we take a brief look at computer memory. This will clarify several points with regard to all the graphics modes.

In standard mode, everything you see on the screen is governed by a special area called *screen memory*, a 1000-byte block of RAM.

RAM—Random Access Memory—is the free memory in a computer, an area available for holding data the user types in. A byte, the primary building block of computer memory, can be thought of as an empty box which can hold any value from 0 to 255. Each byte is subdivided into eight *bits;* it is the arrangement of these bits that determines the number stored in the byte. Bytes have addresses, almost as if they were houses located on one very long street. The first byte of RAM in the 64 has address 0, the second is 1, the third is 2, and so on. (Addresses, like most numbers in computers, start at 0. The computer number is therefore 1 less than the number you would normally expect to see.)

Normally, screen memory on the 64 occupies the thousand bytes from address 1024 to address 2023. Each byte in screen memory corresponds to one *character cell* on the display screen. A character cell is a fixed 8 × 8–pixel block on the screen. Standard 64 text and graphics characters each occupy exactly one of these cells. As you probably know, the 64's regular text display is 40 columns wide by 25 lines high—in other words, 40 × 25 character cells. That's 1000 cells, exactly matching the number of screen memory bytes. Address 1024 controls the character cell in the top left corner of the screen, 1025 is the next cell to the right on the same row, and 1063 is the rightmost cell of that row. The next row starts with 1064 (1024 + 40 character cells) and ends with 1103 (1064 + 39 cells). This pattern is repeated for the entire screen, until the final cell, 2023, is reached. Type in the following program for a demonstration:

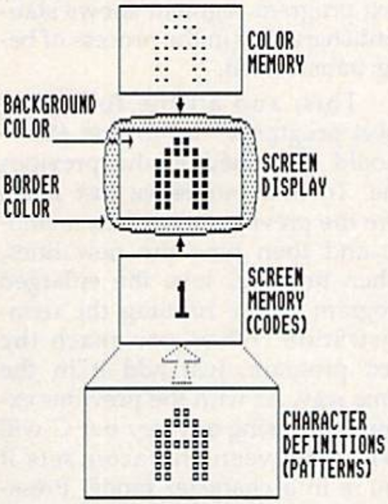
```
10 POKE 53281,0:PRINT CHR$(147
   )
20 POKE 1024,1:POKE 1024+1,2:P
   OKE 1024+39,3
30 POKE 1024+40,4:POKE 1024+99
   9,26
40 POKE 55296,2:POKE 55296+1,2
   :POKE 55296+39,2
50 POKE 55296+40,2:POKE 55296+
   999,2
60 GOTO 60
```

When run, this program displays the capital letters *A, B, C,* and *D* in the first four locations mentioned. A Z should appear in the final character cell on the screen.

Screen Codes And Color Controls

Within the program listing, you won't find these letters in a readable form. Instead, numbers are being POKEd directly into the addresses. Try altering the numbers and addresses to see what happens, but be sure the addresses lie within the range 1024–2023 (screen memory). Any other values will probably cause problems. The numbers POKEd must run from 0 to 255—the only legal range for POKEs on the 64. The numbers POKEd into screen memory are called *screen codes.* (Tables of these codes are found as appendices in most programming books.) The screen code does not actually produce the display you see. Instead, it directs the computer to get its image information from a special area of memory, *character memory.* In this area are stored patterns for each of the characters you can type directly on the keyboard. Each of these patterns, or *character definitions,* will fill a character cell and take up eight bytes in character memory.

The screen code is simply a guide to the particular eight-byte group needed to produce any particular graphic. For example, the letter *A* has a screen code of 1, which means that its character definition is the second pattern in character memory. (Remember, we're counting from 0 again. Incidentally, 0, the first code, is the screen code for @.) All the codes for letters are numbered as you might expect, the alphabet finishing at code 26, Z. With this information about screen codes, it might be helpful to experiment with the previous example program again.



STANDARD CHARACTER MODE

In lines 40 and 50 of the program, you'll notice a number of additional POKEs. These start at address 55296 and then move upward by exactly the same amounts as the screen memory POKEs in lines 20 and 30. As we can now see, screen display is a complex process, and there's yet another area of memory involved in standard character mode: *color memory,* a thousand fixed bytes of memory starting at address 55296. This area is normally dedicated to color control for screen memory. The color-memory bytes are arranged in exactly the same pattern as that of screen memory. Lines 20–30 and 40–50 show how identical increases in addresses result in the correct character cell being affected for both appearance or color. *Color codes* on the 64 are numbered 0–15 and produce the machine's 16 colors. In lines 40 and 50, try altering the 2's, which represent red, to other color codes.

There are two other color controls in this mode. Addresses 53280 and 53281 determine border and background color, respectively. In line 10 of both the programs we've looked at so far, you'll find POKEs to at least one of these addresses. Color codes on the 64 are uniform, so these two addresses respond to 0–15, as well. The figure preceding illustrates the various components that play a part in displaying standard character mode.

Fortunately, BASIC makes it easy to bypass the complex route to this graphics mode. The PRINT command offers a way to control the position and color of characters without worrying about codes, memory areas, or POKEs. PRINT operates in a fairly straightforward way, and it will work in direct mode—that is, without being in a program. The first program you typed in makes extensive use of PRINT.

PRINT is a fast and effective way to display graphics in this mode, but it lacks the precision and flexibility of POKEing directly to screen and color memory. Using PRINT and the special CHR$ codes to control color and cursor movement is an especially powerful technique, but makes program listings hard to read.

A detailed look at the complexities of screen codes and character definitions is beyond the scope of this article, but some additional information may be helpful. Two full sets—consisting of 256 characters each—of definitions are normally available for your use. One consists of numbers, capital letters, and lots of graphics; the other offers fewer graphics, but adds lowercase letters. Normally, only one set can be used at a time. The easiest way to switch between the sets is just to press the Commodore-logo key and the SHIFT key simultaneously. Each time these keys are pressed, the other set of definitions shifts into place. Any characters currently displayed on the screen will instantly alter to reflect the change. The definitions can also be switched from within a program. The following example shows the effect. (Be sure to save a copy of this program—we'll be using it later.)

```
10 C=Ø:FOR I=Ø TO 31:READ N:C=
   C+N:POKE 828+I,N:NEXT
2Ø IFC<>49ØØTHENPRINT"ERROR IN
    1Ø-5Ø":STOP
3Ø DATA 173,24,2Ø8,73,Ø2,141,2
   4,2Ø8,96
4Ø DATA16Ø,Ø,132,251,169,216,1
   33,252,162,4,169,14,145,251
   ,2ØØ,2Ø8,251,23Ø,252
5Ø DATA 2Ø2,2Ø8,246,96
6Ø SYS654Ø9:SYS837:V=53248:BK=
   V+33:POKEBK,Ø
7Ø SM=1Ø24:CM=55296:FOR I=Ø TO
    255:O=172+I+24*INT(I/16):P
   OKESM+O,I
8Ø POKE CM+O,I/16-(I<16):NEXT
9Ø POKE198,Ø:BO=PEEK(BK-1)AND1
   5:POKEBK-1,14+(BO=14)*14
1ØØ GETR$:ON-(R$="")-2*(R$="G"
    )GOTO1ØØ,12Ø
11Ø SYS828:GOTO1ØØ
12Ø IF(PEEK(V+24)AND6)=6THENSY
   S828
13Ø IFSFTHENRETURN
69Ø POKEBK-1,1:POKE198,Ø:WAIT1
   98,1:SYS654Ø9:END
```

Initially, the program displays all the graphics from one set by POKEing screen memory with the 256 possible screen codes. The character set is displayed in a block made of 16 rows of 16 characters each, with 15 of the 64's colors visible. The sixteenth color, black, couldn't be used since it would be invisible against the black background. Pressing on any key other than G will switch to the other character set. A further press will bring back the first set, and so on. Pressing G (for Go on) will allow you to get out of the program. The last line, 690, is especially important. It's used now, and later, to terminate the display. When this line is reached, the border turns white, and you can exit to the normal screen by pressing any key.

You'll notice a couple of interesting points about the two character sets. Rapid switching back and forth (use a repeating key, like the space bar, to facilitate this) reveals that about half the characters are common to both sets. Also, the bottom half of each set is a reversed version of the top. The sets are arranged this way to give the maximum flexibility for programming and screen displays. The mechanics of switching sets is rather complex, but an easy way to do it is provided by BASIC. PRINT CHR$(142) gives the uppercase-only set, and PRINT CHR$(14) gives the lowercase and uppercase set. As you've seen, set switching has no effect on colors. They are controlled by color memory, which is unaffected by the switching procedure.

By the creative use of one of these sets and by changing the colors of appropriate characters and graphics, some fairly impressive screen displays are possible.

Programmable Characters

Standard character mode offers an even more flexible alternative: *standard programmable characters.* Up to now, the characters we've seen have been governed by character definitions stored in ROM (Read-Only Memory), a fixed nonprogrammable area of memory. It's possible to divert the 64's attention away from the ROM patterns, and make the computer look at RAM. Once this is done, we can place any values we want there, altering the patterns to suit our own uses. The next program segment shows standard characters in the process of being transformed.

This, and all the following short programs—up to line 680—should be joined to the previous one. To link programs, just make sure the previous stage is in memory, and then type the new lines. When finished, save the enlarged program before running the demonstration. When you reach the next program, just add it in the same way. As with the previous example, pressing any key but G will switch between character sets if you're in a character mode. Pressing the G key will allow you to go on to the next module once you've started linking the programs together. The border will change color to notify you when the keyboard is waiting.

```
14Ø C=Ø:FORI=ØTO48:READN:C=C+N
   :POKE679+I,N:NEXT
15Ø IFC<>5814THENPRINT"ERROR I
   N 14Ø-18Ø":STOP
16Ø DATA12Ø,169,51,133,1,162,1
   6,16Ø,Ø,14Ø,193,2
17Ø DATA14Ø,196,2,169,2Ø8,141,
   194,2,169,48,141,197,2,185,
   1,1,153,1,1,2ØØ
18Ø DATA 2Ø8,247,238,194,2,238
   ,197,2,2Ø2,2Ø8,238,169,55,1
   33,1,88,96
19Ø C=Ø:FORI=ØTO27:READN:C=C+N
   :POKE728+I,N:NEXT
2ØØ IFC<>3724THENPRINT"ERROR I
   N 19Ø-22Ø":STOP
21Ø DATA 16Ø,Ø,162,24,169,32,1
   41,233,2,14Ø,232,2,173,4,22
   Ø,153,1,1
22Ø DATA 2ØØ,2Ø8,247,238,233,2
   ,2Ø2,2Ø8,241,96
23Ø SF=1:SYS679:POKEV+24,29
24Ø CD=12288:T=5Ø:SYS728
25Ø FORB=ØTO7*T:POKECD+32*8+IN
   T(B/T),Ø:NEXT
26Ø FORI=ØTO255:FORB=ØTO7:POKE
   CD+I*8+B,I:NEXT:NEXT
27Ø GOSUB9Ø
```

Now when you run the combined program, it will repeat the

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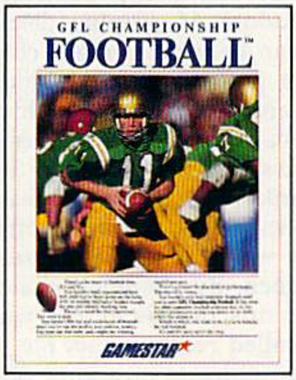

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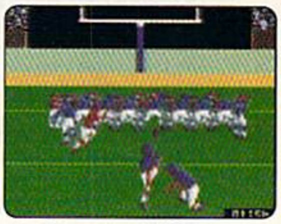

Commodore 64-128 screen

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earlier standard character display. But as soon as you see the screen border turn black, you can press G to watch programmable characters being made.

Here, you'll see the uppercase and graphics set displayed briefly, and then turned into what's commonly described as "garbage." The program has shifted from ROM to RAM for character patterns. However, there are nothing but random values in those bytes, hence the disorganized display.

The screen doesn't stay disorganized for long. First, the pattern in the bulk of the screen begins to clear away and return slowly to the familiar black background. This is because the definition for the first character in the third row of the display is being blanked out. (This is the pattern corresponding to screen code 32, a blank space.) Since each 8-byte, or 64-bit, definition corresponds to an 8 × 8–pixel (or 64-pixel) character cell, it's not a great surprise to discover that each bit in the definition controls one pixel on the screen. Blanking out the pixels simply requires turning off every bit in the definition. Once this transformation is complete, the rest of the character set is changed into blocks of short vertical lines. Notice what happens when the pattern for a space is changed again. When all the characters are done, press any key (avoid G at this stage) to examine the other character set. You'll see that it appears completely normal. Actually, both this set and the other, rather unusual set are programmed characters whose patterns are stored in RAM. The lowercase set was copied very rapidly from ROM into RAM at the start of this example.

Now add the next program module:

```
280 FORI=0TO31:FORB=0TO7:AD=CD
   +I*8+B:POKEAD,PEEK(AD+2048)
   :NEXT:NEXT
290 FORB=0TO7:POKECD+160*8+B,P
   EEK(CD+B):NEXT:PRINT"PRESS
   {SPACE}THE RETURN KEY"
300 GETR$:IFR$<>CHR$(13)THENPO
   KE204,0:GOTO300
310 POKE204,1:FORB=0TO7:READCH
   :POKECD+B,CH:NEXT
320 DATA 130,68,124,84,124,56,
   16,0
330 FORB=0TO7*T:AD=CD+INT(B/T)
   :POKEAD+32*8,PEEK(AD):NEXT
340 GOSUB90
```

When the new section is running, you'll see the top two rows of vertical bars converted into the first part of the lowercase set, and the first character of the eleventh row converted to an @ sign. This character has screen code 160, the code for a reversed space. Once these changes are over, you'll see a screen message asking you to press the RETURN key. This is accompanied by a flashing cursor in the shape of the @ sign. The cursor always works by alternating the character it's resting on with the reverse of that character. Normally, this gives the effect of a flashing block. With our mutated characters, the effect is quite different. Once you've pressed the RETURN key, another transformation takes place. The @ sign that's the first character in the display is converted into the head of a small animal. Then, so that you'll have time to watch, this pattern is transferred slowly into the area that holds the space character. As a result, the majority of the screen is soon covered with multiple copies of the creature's face. For some technical notes on how the face was created, refer to the sidebar accompanying this article.

Standard programmable characters are one of the mainstays of Commodore 64 graphic displays. They can be used to make characters for games, different kinds of letters and numbers, and highly detailed backgrounds for games and other displays. As you saw when the blank space so rapidly became a thin vertical line, this mode offers a speedy way to affect large areas of the screen. By changing character definitions in this active way—often called *redefining on the fly*—you can animate any kind of display. Indeed, some arcade-style games rely exclusively on this mode, and use no sprites.

Multicolor Character Modes

To move on to the next category of graphics modes, *multicolor characters*, type in the following program module and rerun the program. As you go through the early sections, pay careful attention to the appearance of the face and to the letters at the bottom of the alternate character set. (This is made available at any time by pressing any key but G.)

```
350 POKE53270,PEEK(53270)OR16
360 GOSUB90
```

When you hit the new section, you'll see the finely detailed animal face dissolve into a blob of indistinct colors. The letters in the still-displayed PRESS THE RETURN KEY message are similarly affected. You'll also notice that while the top half of the character block remains unchanged, the bottom is subtly altered. For a clearer look at the contrast, press a key to display the other character set. Here, you can see that the lower half of the character block is suffering from the same distortion as the RETURN-key message.

This character set shows the appearance of the next 64 graphics mode, *multicolor character mode with standard character definitions.* This mode differs from the previous two mainly in the way it handles color. Although there is still one background color and one main color-memory color per character cell, two additional colors are available per cell. These two colors apply to all the cells.

Even though multicolor mode is clearly active, it's only affecting the bottom half of the character block. This is due to a special property of both the multicolor modes. Multicolor is set *individually* for each of the 1000 screen cells. Once the main multicolor switch is activated (in line 350), each cell is controlled by the color code held in the corresponding byte of color memory. Codes 0–7, the first eight colors, display normal, single-color characters in the same color as the code, like those at the top of the block. Codes 8–15 turn on multicolor in any given cell, but produce main display colors corresponding to codes 0–7.

The bottom eight rows of the character block were constructed with color codes 8–15, so they're the only ones affected by the multicolor mode. If you look closely, you may be able to see that these rows are no longer the same colors that they were in earlier stages. However, colors 8–15 are not completely lost in multicolor mode; they can be used for background or border, or for the two additional multicolor hues.

As you can see, using multicolor with normal character patterns is rather pointless. Characters in colors 0–7 appear unchanged, while

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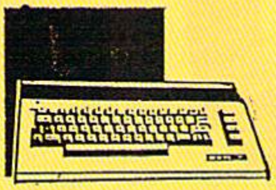

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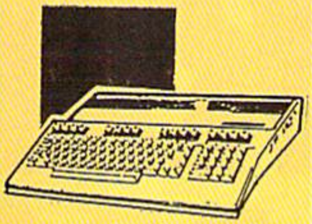

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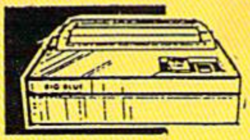

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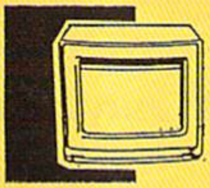

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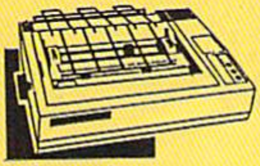

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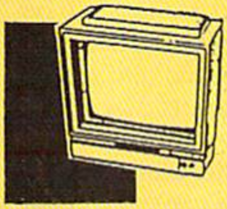

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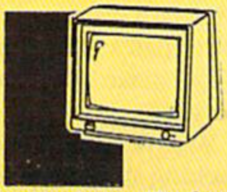

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those in 8–15 are virtually unreadable. Consequently, this mode is hardly ever used. It does, on the other hand, form a good introduction to the next mode. Type in the next module, save it, and then rerun the program, observing the various modes as they go past.

```
370 POKEBK+1,10:POKEBK+2,1:M$=
    "@ A B C D @":PRINTM$
380 FORI=0TO4:FORB=0TO7:READCH
    :POKECD+I*8+B,CH:NEXT:NEXT
390 DATA 68,68,252,152,220,220
    ,48,48
400 DATA 48,204,204,204,252,20
    4,204,204,32,136,136,136,16
    8,136,136,136
410 DATA 16,68,68,68,84,68,68,
    68,48,204,204,136,168,136,6
    8,68
420 FORB=0TO7:POKECD+32*8+B,0:
    NEXT
430 GOSUB90
```

The new mode is *multicolor with programmable characters*, and like the earlier programmable characters, it relies on character definitions held in RAM. This segment of our tutorial program uses this arrangement to change the first five characters in the block, and then reconverts the space pattern into a blank to make the display readable.

You'll see that the RETURN-key message is as unclear as ever, but beneath it, six precisely defined characters appear in a row whose ends are punctuated by a new version of the animal face. This time, the face is made up of three different colors in the same character cell, an impossibility in standard programmable character mode. Also in the row are four differently colored versions of a capital *A*. Like the face, the rightmost of these is comprised of three colors.

In this mode, the 64 uses a special method of decoding character definitions to determine how the four available colors are to be allocated in any cell. This coding method is not used in standard character mode, and a brief glance at the first five characters in the block will show why. As you'll recall, characters in the first eight rows are displayed just as if they were in standard mode. The animal head (in the first, @ sign, position) and the *A*'s look much different here. Not only are they not multicolored, but also all except one of the shapes are distorted and difficult to read. Clearly, these patterns would be unsuitable for standard characters, just as standard patterns are not useful for multicolor.

In essence the coding system is fairly straightforward. In this mode, each character cell is only four pixels wide. Consequently, resolution drops to 160 × 200. The display stays the same width, however, because the pixels all double in width. Thus, there's no change in the size of the cell; it's four fat pixels wide, instead of eight slim ones. The fat pixels are controlled by pairs of bits in the character pattern. Since two bits can represent any number from 0–3, the 64 uses these four possibilities to determine how the three multicolors and the background color will be used in each cell. (More technical information on this topic is available in the accompanying article, "Manipulating Bits.")

This mode is one of the most widely used, since it makes colorful displays relatively easy to achieve. It's very common in games, and its only real drawback is the loss of some horizontal resolution.

Extended Background Color Modes

We now come to the *extended background color* modes.

```
440 POKEV+22,8:POKEV+17,91
450 FORI=0TO3:FORCC=1TO11:SC=A
    SC(MID$(M$,CC,1)):IFSC<>32T
    HENSC=SC+(I-1)*64
460 O=399+CC+I*40:POKESM+O,SC-
    64*(SC=-32):POKECM+O,CC/2+1
470 NEXT:NEXT
480 GOSUB90
```

As you reach this section, you'll see the row of six redefined characters printed anew—repeated four times and somewhat below the original position. There's another change, but it's more easily seen in the other character set, so press a key and take a look. You'll observe that all the graphics have disappeared from this set, and so have the capital letters. In fact, there are now only 64 characters in the set, instead of the full 256. You'll see that the first 64 characters appear four times in the block—once on the normal background color, and three times on differing background colors.

In this mode, each character cell has its own background color associated with it. This effect is most easily seen in the rows displayed at the left of the main character block. Normally, only one background color is available in character modes; the extra ones here give these modes their names.

This screen portrays *extended background color mode with standard ROM character patterns.* You'll note that the RETURN-key message and all the graphics below it are quite readable again. Extended background color works well in this mode. Its most common use is to provide windows of different colors for text and numeric messages. These can form the basis for effective word processing and business-type programs.

Flip back to the other character set for a look at *extended background color mode with programmable characters.* Here again, you'll see four repeated bands of the first 64 characters. These no longer show any effects of multicolor mode, which is totally inoperable with extended background color. As you can see, although it's practical to make programmable characters in this mode, fine detail tends to get lost in at least one of the three background colors. Also, since only 64 character patterns are allowed in this mode, redefining a significant proportion of them tends to leave too few alphanumeric characters for screen messages. This mode is not widely used.

The next brief program segment merely reprograms the sources from which the extra background colors are derived:

```
490 POKEBK+1,1:POKEBK+2,7:POKE
    BK+3,11
500 GOSUB90
```

These are the same as the two special addresses used in multicolor, plus an additional location. These, together with the main background color, form the background palette for this mode. The programmer selects one of the four colors by means of screen codes. Since only 64 characters are now available, extra information is taken from the screen code to determine which extended background color will be used. Codes 0–63 give the 64 characters on the normal background; codes 64–127 (64 plus 0–63): extended color source 1; codes 128–191 (128 plus 0–63): source 2; and 192–255 (192 plus 0–63): source 3. Any of the full range of 16 colors may be used for the colors of the characters themselves.


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Bitmapped Modes

The following program segment moves us out of the realm of character display completely. As usual, we'll encounter twin modes. These are the *bitmapped modes,* also known as *hi-res modes.*

```
510 POKEV+17,59:HI=8192
520 FORI=0TO999:FORB=0TO7:POKE
    HI+8*I+B,0:NEXT:NEXT
530 PRINTCHR$(147):SYS837
540 O=3843:FORI=0TO39:POKEHI+O
    +8*I,255:NEXT
550 FORI=0TO24:FORB=0TO7:FORN=
    1TO3:AD=HI+5*(N+1)*8+40*8*I
    +B
560 POKEAD,PEEK(AD)OR(16*N)
570 NEXT:NEXT:NEXT
580 FORI=0TO39:POKESM+480+I,I:
    NEXT
590 GOSUB90
```

Running this portion of the program creates a much-changed screen image. This is a standard hi-res display. Although there's still a block in the center of the screen, there are no characters in it—just colors. The orientation of the colors has altered, too. Once again, all 16 colors are displayed in the block, but are now running vertically instead of horizontally. Blocks of color also appear wherever other characters were formerly displayed. There's been a change in the way the 64 is handling color. In bitmapped mode, color information comes entirely from the area that would be screen memory in a character display. The colors you see are generated by the screen codes that are still in position from our character displays.

The basic pattern of the screen image has changed as well. About half the screen is a jumble—the kind of garbage we saw earlier in the first stages of redefining characters—and the lower half is most of both our character sets. This shows us that the screen is still organized in character-cell manner, but what exactly are we looking at?

Up to this point, we've seen characters fetched indirectly from character memory via their screen codes. Even though the character images we now see on the screen appear identical, the indirect part of the process has been eliminated. We're looking directly at character memory itself. However, most of both character sets are visible (you may want to rerun the program to check this). Two full character sets occupy only 4048 bytes, and a hi-res screen requires 8000. That's why there's room for the additional random patterns at the top of the screen. However, the computer has strict rules about where character memory and hi-res screens may be located. In this case, the top of the screen is filled with 4048 bytes of random patterns, leaving only 3952 bytes of hi-res screen. This is not enough for both character sets: If you look closely, you'll notice that the second set is not completely displayed.

By now, you'll have noticed that the screen is slowly being blanked out. Here, unlike the character modes, each byte—hence, each bit—must be zeroed out individually to clear the screen. In the bitmapped modes each bit must be programmed—mapped—to produce a screen display. After all the patterns have been blanked out, the colors will suddenly be cleared, too. The program does this by issuing the same command that's used to clear the normal screen of screen codes. In this case, that places color codes for a black background and red images into all the cells of screen memory. And, once the screen is totally cleared, you'll observe four red lines being drawn. The first of these—a horizontal line—is plotted rapidly; the other three—vertical lines of varying widths—much more slowly. The difference in speed occurs because the three vertical lines are checking for existing screen images as they make their way down the display. They might otherwise obliterate already established graphics.

Once the vertical lines are done, a full range of background colors will be displayed along the horizontal line, and the line itself will take on a number of different hues. Color codes have been intentionally pushed into screen memory to create this effect. In this mode, each eight-byte hi-res cell—a character cell whose pattern must be programmed directly—may have one background color and one image color. The effect is somewhat similar to color in extended background color, but here there are no limits on the patterns, and the full range of colors may be used in any one cell.

This mode offers the 64's highest resolution and most flexible possibilities for detailed imagery. All the screen displays in the *GEOS* system are drawn in this mode. Colors here can be much richer and more varied than is often thought—there has been some confusion on color in this mode. However, some commercial software does support full standard hi-res colors. Notable examples among older programs are *Doodle* and the *Flexidraw* system; the current 1.2 version of *geoPaint* in *GEOS* also includes full color support.

Multicolor Bitmapped Mode

This brief program brings us to the final full-screen graphics mode, *multicolor hi-res.*

```
600 POKEV+22,24
610 GOSUB90
```

When you get to this stage, you'll see that the lines from the previous display are now different colors—one has turned black and thus disappeared—and that the verticals are equally wide. This is much like the similar effect found in multicolor character mode.

Multicolor hi-res also offers 160 doubly wide horizontal pixels by 200 vertical. Here also, the doubly wide pixels control four color sources. In this mode, there is one background color for the entire screen, but three separate image colors for each cell. As in standard hi-res, two 0–15 color codes are accommodated in the screen-memory area. This mode's additional color is derived from the familiar color-memory area.

```
620 FORI=0TO24:O=10+40*I:POKEC
    M+O,I:POKESM+5+O,5
630 POKESM+10+O,I*10:NEXT
640 FORI=0TO7:FORB=0TO7:O=80+2
    6+40*I+B:POKESM+O,18:POKECM
    +O,6:NEXT:NEXT
650 FORI=2TO7:FORB=0TO7:AD=HI+
    240+320*I+B:POKEAD,PEEK(AD)
    OR16
660 AE=HI+1812+B*8:POKEAE,255:
    POKEAE+1,255
670 AF=HI+280+312*I+B:POKEAF,P
    EEK(AF)OR2↑(2*(INT(B/2))+1)
680 NEXT:NEXT
```

This is the last segment in our odyssey through the character-based pairs of the 64's graphics modes. In this section, new colors are applied to the existing three lines, and three more are drawn in the top right corner of the screen. These three differently colored lines intersect without color interference. This property is the great

Manipulating Bits

Lee Noel, Jr.

A better understanding of character definitions and the display they produce requires another look at memory structure. Each byte of memory is broken down into eight bits. The term *bit* is often said to be a contracted combination of the words *bi*nary and dig*it*. While some dispute this origin, it does provide a hint at one of the characteristics of this smallest unit of computer memory.

The 64 is a digital computer, a collection of minuscule on/off switches. Obviously, an on/off switch has only two possible positions. These positions are used within the computer to represent numbers. An *on* switch is 1; an *off* switch is 0. This structure then lends itself to the binary number system—a system composed simply of 1's and 0's. This is perfect for the 64, but very difficult for us.

Looked at in this way, we can see that ROM is a set of on/off switches permanently frozen into patterns, while RAM is a set of flexible switches that can be moved into any position dictated by a program. This flexibility is not free of cost—without electric power, the RAM switch settings are jumbled and lost completely. In essence, tape and disk storage amounts to nothing more than RAM switch settings that have been preserved for later use by the computer.

Bits And Graphics

There's actually little reason to deal formally with the binary number system when working with graphics on the 64. We do need to have an understanding of the individual bit switches, but our everyday decimal number system gives us all the tools required.

Bits are important because they provide a precise way of looking into each byte of memory. To return to the metaphor of houses on the street (used in the "Fundamentals" story), bits give us a way of accessing exactly any of the eight small, identical rooms that comprise each house. As you'll see shortly, all that really matters is whether bits are on or off. This information does need to be put into numerical form, but we'll detour around the binary system and get on with the graphics. The figure below shows how bits are arranged within a byte. (Note: All bytes on the 64 have this structure.)

BYTE STRUCTURE

7	6	5	4	3	2	1	0	←BIT NUMBER
128	64	32	16	8	4	2	1	←BIT VALUE
(2^7)	(2^6)	(2^5)	(2^4)	(2^3)	(2^2)	(2^1)	(2^0)	

As you see, the eight bits are numbered 0–7, starting from the right. Each bit is shown holding a number. For example, bit 5 contains 32. These numbers represent the decimal number value for each bit when it's on. An off bit has a value of 0, regardless of its position within the byte. The numbers in parentheses below the bits show the bit value expressed as a power of 2. Thus, 32 is 2↑5, or 2 * 2 * 2 * 2 * 2. Bit 0 has a value of 1 when it's on. Mathematically, any number to the power of 0 is 1. These parenthetical expressions are closely related to the binary form of the number, but, for our purposes, they merely provide a useful method for remembering the *on* value of each bit. (There's also a glimpse here of why it's useful to start numbering from 0.)

BYTE VALUE

128	64	32	16	8	4	2	1	←BIT VALUE
O	O	X	O	O	X	O	X	←BIT STATUS

32 + 4 + 1 = 37

Instead of looking at the byte as 1's and 0's, let's consider it as a sort of horizontal tic-tac-toe arrangement. An X will represent an *on* bit, and an O will be off. In the figure, bits 5, 2, and 0 are on. The total value for the byte is simply the total value of the individual *on* (X) bits—in this case, 32 + 4 + 1, or 37.

The minimum value for a byte is 0—all bits off. The maximum is 255, 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1—all bits on. All the intermediate values are possible, producing 256 byte values. This is why POKEs—which store a decimal numeric value into a given address—are limited to this range. The program below, "Bitpeeker," lets you enter any valid 64 address, and see the number stored there in both decimal and X/O bit-pattern form.

```
10 PRINT CHR$(147):INPUT"ADDRE
   SS";AD
20 IF AD<0 OR AD>65535 THEN 10
30 N=PEEK(AD):PRINT"PEEKING"AD
   "GIVES"N:PRINT
40 PRINT SPC(3)"BIT PATTERN"
```

```
50 FOR I=7 TO Ø STEP -1:PRINT
   {SPACE}CHR$(98)CHR$(119+(2↑
   I=(N AND 2↑I)));:NEXT
```

To make programmable (or custom) characters, all we need to remember is the simple bit/byte chart in the previous figure. Since a character definition is just eight consecutive bytes of pattern information, all we have to do is supply our own pattern once the 64 is "looking" in the right direction. The figure below shows the eight-byte off/on pattern needed to make the face character displayed in lines 310–330 from the main article. As you can see, calculating the numbers required is a straightforward exercise in addition.

								BYTE VALUES ↓
X	O	O	O	O	O	X	O	128+2=130
O	X	O	O	O	X	O	O	64+4=68
O	X	X	X	X	X	O	O	64+32+16+8+4=124
O	X	O	X	O	X	O	O	64+16+4=84
O	X	X	X	X	X	O	O	64+32+16+8+4=124
O	O	X	X	X	O	O	O	32+16+8=56
O	O	O	X	O	O	O	O	=16
O	O	O	O	O	O	O	O	=0
128	64	32	16	8	4	2	1	←BIT VALUES

PROGRAMMABLE CHARACTER PATTERN

AND And OR—The Logic Testers

With programmable graphics, one bit will often correspond to one pixel on the 64's screen. Hi-res graphics operates on the same principle, but requires even finer control. Instead of predefined character patterns being used in the display, detailed, possibly transitory, images are directly plotted on the screen.

This means that the programmer must be able to nondestructively examine and alter any of the 8000 bytes making up the hi-res screen. Generally, it's not practical just to POKE blindly to the screen: Such POKEs would be likely to wipe out any information already in a byte. We need a method for turning individual bits on and off without disturbing other bits in the same byte.

To illustrate, imagine a hi-res byte holding the value 32—one with only the fifth bit on. To turn on bit 0, it might seem logical to POKE the byte with a value of 1. While this would turn on bit 0, it would put a total value of 1 into the byte, thus turning off bit 5.

Another use for this precise control of bits is related to the switchlike nature of computer memory. Bits at some locations actually do act as switches, turning some of the 64's components off and on. Some addresses control many functions. A good example is address 53270, which turns on multicolor mode in line 350 of the demo program. Make sure any program in your 64 is saved, and then try this POKE:

```
POKE 53270, 32
```

The screen should go blank. RUN-STOP/RESTORE will return everything to normal, but if you run into problems, you can turn your 64 off since your program is safe. Location 53270 obviously does more than switching multicolor. Fortunately, AND and OR provide a way to avoid blindly flipping whole bytes of sensitive bit switches.

BASIC's AND and OR functions give us the fine control necessary to successfully undertake precise operations. AND and OR are known as *logical operators*, but understanding them often seems to stretch logic to its limit. As a result, we're going to try another detour.

Using the tic-tac-toe marking scheme we developed for programmable characters, we're going to convert ANDing and ORing into a simple geometric game.

Game Plan

- Object of the Game: To turn on or off one or more bits (pixels) in a hi-res screen byte, without disturbing the other bits. We'll call this original byte the *target byte*, and its address the *target address*.
- The Method: We create another number, another byte value, which is ANDed or ORed with the target byte to produce the *result byte*. We'll call this modifying value the *modifying byte*.
- The Rules: Use AND to turn bits *off*; use OR to turn bits *on*. (This is easy to remember. *And* and *off* each have three letters; *or* and *on* have two.)

The figure shows how this works in practice.

THE AND GAME

	128	64	32	16	8	4	2	1	
TARGET	X	O	X	O	X	O	X	X	=171
MODIFIER	O	O	O	O	X	X	X	X	=15
RESULT	O	O	O	O	X	O	X	X	=11

BASIC EQUIVALENT: POKE TARGET, PEEK(TARGET) AND 15

HERE, THE Os TURN ANY BIT OFF, WHILE THE Xs PROTECT THE TARGET BITS, WHETHER THEY'RE ON OR OFF.

THE OR GAME

	128	64	32	16	8	4	2	1	
TARGET	X	O	X	O	X	O	X	X	=171
MODIFIER	O	O	O	O	X	X	X	X	=15
RESULT	X	O	X	O	X	X	X	X	=175

BASIC EQUIVALENT: POKE TARGET, PEEK(TARGET) OR 15

HERE, THE Xs INSURE THAT ANY BIT IS ON, WHILE Os PROTECT THE TARGET BITS, WHETHER THEY'RE ON OR OFF.

In ANDing, O's force bits off, while X's are used to protect bits that are not to be changed. In ORing, X's force bits on, while O's protect those which are not to be changed.

While not obvious at this stage, neither operator has the power to turn bits on and, at the same time, turn bits off. To do this requires the use of both operators in tandem. Although AND and OR are essential to producing hi-res graphics, they aren't needed to appreciate the displays.

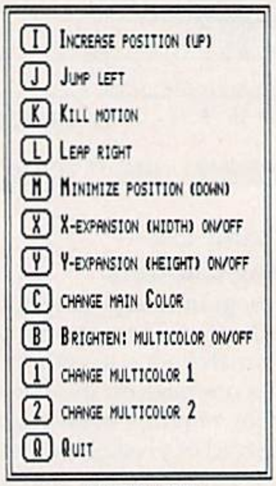
If you do want to delve into the use of these operators, load and keep the Bitpeeker program in memory and try direct-mode POKES to various addresses. You can then use the Bitpeeker to see if you've achieved the pattern you planned. Some addresses are sensitive, so you might want to POKE to screen memory, where you'll see the results (color memory permitting).

You can see AND and OR in use at several points in the example programs in the main article. The logical operators are used to switch graphics modes off and on, and they're also crucial to plotting intersecting hi-res lines in program lines 560, 650, and 670.

strength of multicolor hi-res, and accounts for the mode's widespread use. Most hi-res pictures are in this mode, and it's popular for creating game backgrounds. Most drawing and painting programs also operate in this mode, which takes more memory—8000 bytes for images and 2000 for color—than any other on the 64.

Sprites

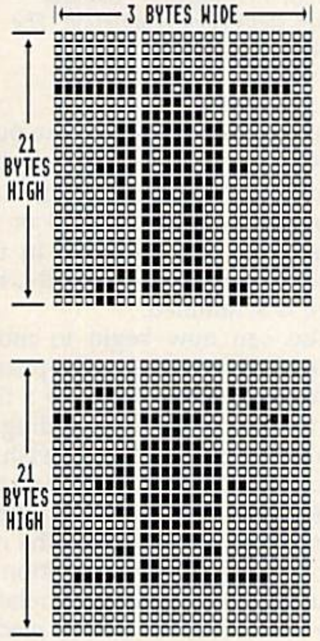
No survey of graphics on the 64 would be complete without a look at the machine's famous *sprites*. Originally known as *movable object blocks*, or *MOBs*, these graphic wonders exist separately from the other modes and have the capability to move about in a very spritelike fashion. A program to demonstrate most of the important sprite features follows this article. The program is controlled via the keyboard; refer to the diagram for details. Once you have the demo typed in and running, it will operate by itself until you press a key.



CONTROL KEYS

There are two sprite modes, but both have a number of common characteristics, so we'll explore these before moving on. There are eight sprites, numbered 0–7, and each is defined by 63 bytes of data. A *sprite definition* is something like a large character definition, but there are no character cells for sprites. They are free to move anywhere on the screen, and are even able to keep moving when they go beyond the screen borders. Sprites are built directly into the hardware—the circuitry—of the 64, and thus give the graphics programmer a special advantage. By simply switching bits in a few memory locations, called sprite registers, programmers call up (enable) sprites, send them whizzing round the screen, animate them, change their sizes and colors, and make them disappear—all this with a relatively small amount of programming, and with little effect on other parts of a program. Of the newer computers, only the Amiga has hardware sprites; the others create similar shapes in software (programs) and rely on their high-speed microprocessors to provide swift motion and other features.

The 63-byte sprite definition is a block 3 bytes wide by 21 bytes high. Two definitions are used in the demo program. The animation of the creature on the screen is caused by flipping rapidly back and forth between them. The following figure shows these definition patterns, which are coded byte by byte just like the programmable character discussed in the accompanying article:



SPRITE PATTERNS

Once created, the definitions can be stored in almost any 64-byte block of memory. (The extra byte is needed for technical reasons.) Although there's a limitation on where these blocks may start, they are otherwise not restricted, and can be tucked into various out-of-the-way places. The 64 learns of the location of a definition from the *sprite pointers,* eight bytes reserved for this purpose at the end of the full 1024 bytes of screen memory, only 1000 of which are needed for screen codes. In a sense, this is a special kind of screen memory for sprites. Just as the normal screen code points to a character definition, the sprite pointer targets the desired sprite definition. Switching the value in a pointer instantly picks out another block, and this is the basis for the animation in the demo.

Sprites are capable of other, near-miraculous, things: They can be enlarged horizontally, or vertically, or both; they can be made to pass on top of, or behind, other graphics, thus creating the illusion of three dimensions; they have a system of priorities (rankings) in passing over each other that—among the eight sprites—creates a great sense of depth; and they can even be set to check whether they've collided with each other or any other screen graphics. They can seem to have a sort of pseudolife of their own, so it's no wonder their less formal name became standard.

The two sprite modes are *standard mode* and *multicolor mode.* In standard mode, each sprite has only one color, but every bit in the full three-byte width of the definition controls a pixel, giving a 24-pixel horizontal resolution. These single-color sprites can be quite detailed.

Multicolor-mode sprites work like the other multicolor modes on the 64. Horizontal resolution is halved, but two new color sources can be brought into play by the two-bit-wide pixels. Much like multicolor characters, these two additional sources are common to all the sprites, but the main color for each sprite is still individually determined. Color sources for both kinds of sprites are independent of all other colors on the machine. The same 16 color codes are used, however, and may be applied anywhere within the sprite system.

The demonstration program allows you to experiment with both modes, change all the colors, try expansions, and observe the three-dimensional effects of the sprite passing over and under characters on the screen. Sprites are independent of the other graphic modes and can be used with any of them. Sprites are commonly used as cursors or special window displays in text-oriented programs. Their most popular use is probably as animated characters in games, but that's just a single segment in the wide range of 64 graphics modes.

Sprite Demonstration

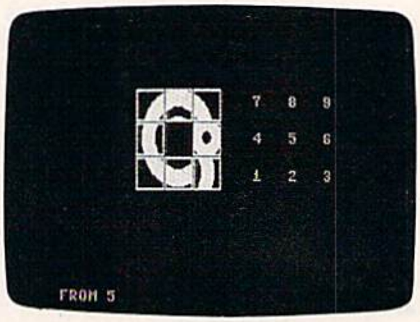
Before typing in this program, refer to "How to Type In COMPUTE!'s Gazette Programs," which appears elsewhere in this issue.

```
CG 1 PRINT"WORKING":FORAD=832T
     O959:POKEAD,Ø:NEXT:Q=255
KM 2 PRINT".";:READN
HD 3 IFN>QTHENAD=N:GOTO2
HC 4 POKEAD,N:IFAD<879THENPOKE
     AD+64,N
SX 5 AD=AD+1:IFN<>240THEN2
BS 6 DATA842,48,Ø,255,239,252,
     Ø,48,Ø,Ø,252,Ø,3,187,Ø,3,
     187,Ø,3,187,Ø,15,187
AC 7 DATA192,2,254,Ø,3,171,Ø,Ø
     ,204,Ø,Ø,204,Ø,Ø,204,Ø,Ø,
     204,Ø,Ø,204,Ø,3,207
BE 8 DATAØ,12,204,192,12,Ø,192
     ,902,12,Ø,192,51,51,48,19
     2,220,12,918,119,921,119
MC 9 DATAØ,15,119,192,1,253,Ø,
     3,87,Ø,Ø,252,938,3,3,944,
     63,207,240
AR 1Ø P=256:V=53248:POKE V+32,
      Ø:POKE V+33,Ø:PRINTCHR$(
      147):POKEV+21,1:POKE646,
      6
CD 25 B$=CHR$(184):FORI=1TO4:B
      $=B$+B$:NEXT:M$(Ø)=B$:M$
      (4)=M$(Ø):N=1
DG 3Ø M$(1)="THE SPRITE WILL":
      M$(2)="PASS UNDER THESE"
      :M$(3)="LETTERS"
GM 35 M$(5)="ABOVE":FORI=ØTO4:
      PRINTTAB(N)M$(I):NEXT:N=
      N+22:IFN<4ØTHEN35
DC 37 FORI=ØTO2:PRINTCHR$(145)
      ;:NEXT:PRINTTAB(N-22+5)M
      $(5)
QR 4Ø XLO=1ØØ:X=XLO:XH=Ø:Y=1ØØ
      :DX=1:DY=Ø:R=29:B=13:C=7
      :C1=1:C2=2:GOSUB25Ø
BF 9Ø GETR$:IFR$=""THEN1Ø2
KS 1ØØ R=ASC(R$):ON-(R=81)GOTO
       21Ø
DR 1Ø2 ON-(R<73ORR>77)GOTO14Ø
HM 1Ø5 DX=-(R=76)+(R=74):DY=-(
       R=77)+(R=73)
JS 14Ø GOSUB25Ø:B=B+1+(B=14)*2
       :GOTO9Ø
GS 21Ø POKE V+21,Ø:END
PD 25Ø X=X+DX-512*(X=ØANDDX=-1
       )+512*(X=511ANDDX=1):XL
       O=X+P*(X>Q):XH=-(X>Q)
GE 254 Y=Y+DY-P*(Y=ØANDDY=-1)+
       P*(Y=QANDDY=1)
RC 255 POKE V,XLO:POKE V+16,XH
       :C=C-(R=67)+(C=Q)*P:POK
       E V+39,C
HB 256 W=W-(R=88)+P*(W=Q):POKE
        V+29,W:H=H-(R=89)+P*(H
       =Q):POKEV+23,H
KG 258 MC=MC-(R=66)+P*(MC=Q):P
       OKE V+28,MC:C1=C1-(R=49
       )+P*(C1=Q):POKEV+37,C1
KP 26Ø C2=C2-(R=5Ø)+P*(C2=Q):P
       OKE V+38,C2:POKEV+27,1+
       (XLO<ØORXLO+P*XHI>16Ø)
DG 262 POKE V+1,Y:POKE2Ø4Ø,B:R
       =Ø:RETURN
```

Tile Trader

Michael Wiens and Kevin Black

This classic puzzle comes to life on your Commodore 128. For variety, four different puzzles are included.



Here's the first puzzle—"Bullseye"—only two steps from completion. The final sequence of moves is 6, 3.

"Tile Trader" is an adaptation of an old game in which you begin with an array of misplaced playing squares and must shuffle them around to form a sequence or picture. The most common version is one where you have to put numbers or letters in order. In another version, you have to unscramble a picture. Tile Trader is one of the latter, but it lets you choose between four different pictures.

After you've typed in the program and saved a copy to disk or tape, load the program and type RUN. After the title screen is displayed, you're asked to choose from the four available puzzles. Press a number from 1 to 4. Next you see a picture of the puzzle as it should look when it's solved. The program asks how many moves should be made to mix up the puzzle. At first, try 4 or 5 (a low number for children is recommended). Later, you may want to try 20 or 30 moves. After you've typed in the number and pressed RETURN, the picture is scrambled.

You can now begin to move the tiles, trying to return the puzzle to its original state. To move a tile, press the number corresponding to the position of the tile you wish to move. Although you can use the number keys on the top row of the keyboard, it's easiest to use the numeric keypad, since the position of the numerals there is directly related to the position of the puzzle pieces. The tile moves from the space you specify to the empty square. Therefore it's only possible to move tiles adjacent to the empty block. The computer ignores illegal moves.

When you've solved the puzzle, you'll hear a siren, and the computer will tell you how many moves it took to solve the puzzle. Finally, you're asked if you'd like to play again. Choose *N* to return to BASIC; choose *Y* to try another puzzle.

See program listing on page 105.

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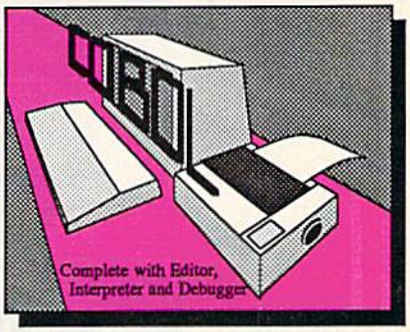

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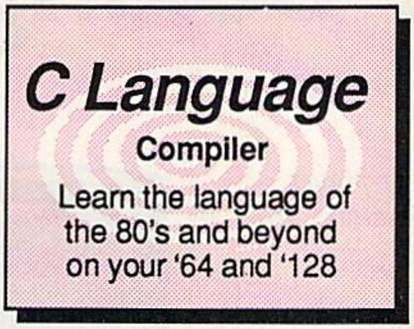

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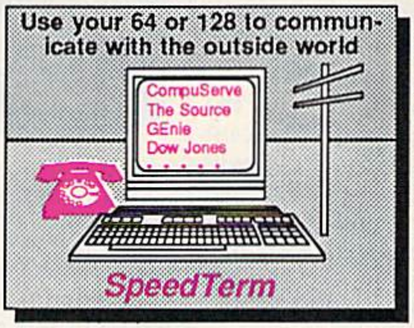

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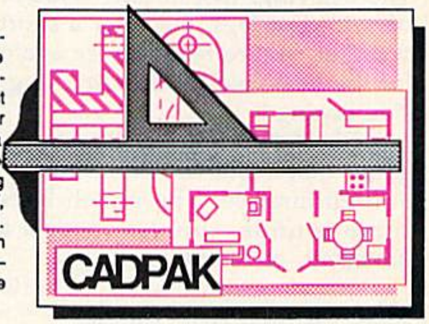

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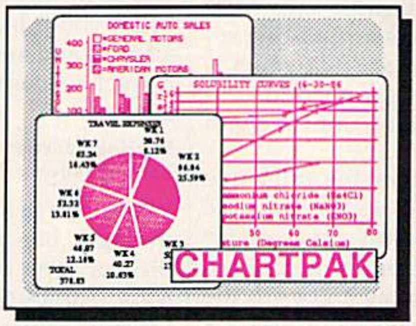

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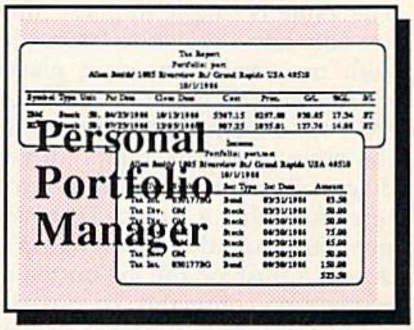

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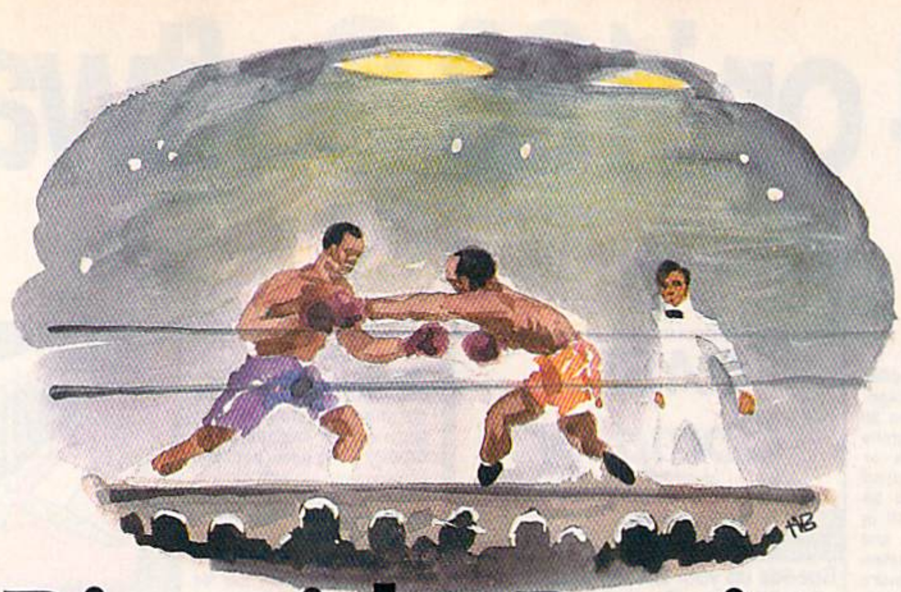


Ringside Boxing

Anthony Bertram

It's the Friday night title bout in this exciting two-player arcade-style game for the Commodore 64. Two joysticks are required.

The bell rings just in time—you're on your last legs. But after a short breather, you're ready to try again for the heavyweight title in "Ringside Boxing."

Ringside Boxing is a two-player game that requires skill, strategy, and endurance. The match lasts three rounds—unless there's a knockout, of course.

Jabs, Hooks, And Blocks

The game is simple to play—there are only a few moves to learn—but with two evenly matched players it's not easy for either to win. Move the stick diagonally up and toward the other player for a jab. Move it diagonally down and toward your opponent for a hook. To block, push the joystick straight up or down. A push on the fire button executes your command. To move left or right, just push the joystick in the corresponding direction.

Each round lasts for three minutes. The clock at the top of the screen keeps the time. When the bell sounds at the end of the round, the two fighters automatically return to their corners. During the break, the boxers' energy goes up slightly.

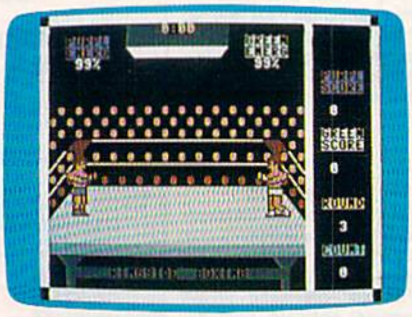
Displayed above each player is an energy rating. It's important to keep an eye on this number. If your energy sinks to 25 percent or less, you'll be knocked down with the next punch. If it sinks to 15 percent or less, the next punch landed will be a knockout. Energy is lost two ways: by punching and by getting punched. Throwing a jab costs one point of energy; getting hit costs two. Throwing a hook costs two points; getting hit with one costs four. Energy is constantly being replenished. If you find that yours is getting too low, it's a good idea to block and back away until the end of the round.

If the fight goes the full three rounds, the score will decide the champion. Five points are given for a scoring jab and ten for a hook. In case of a tie, the match goes to the defending champion—the boxer on the left who wears the purple trunks.

In the event of a knockdown, the count clock begins a ten-second count. If the player can't get up in time, the match is over.

Typing It In

Ringside Boxing is written entirely in machine language. Type it in



You can employ jabs, hooks, and blocks in this two-player action game for the 64.

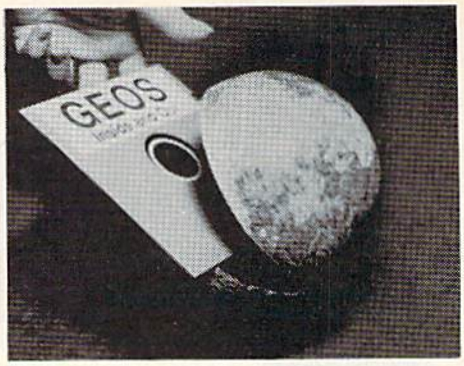
using "MLX," the machine language entry program found elsewhere in this issue. When you run MLX, you'll be asked for a starting address and an ending address. The correct values for Ringside Boxing are:

Starting address: 0801
Ending address: 1AB0

When you're finished typing in all the data, be sure to save a copy to disk or tape before you exit from MLX. Although Ringside Boxing is written entirely in machine language, it can be loaded and run just like a BASIC program. To load the program, type LOAD"*filename*",8 (tape users should substitute a 1 for the 8 in this statement) where *filename* is the name you used to save the file. Then type RUN to start the game.

See program listing on page 107.

GEOS INFO



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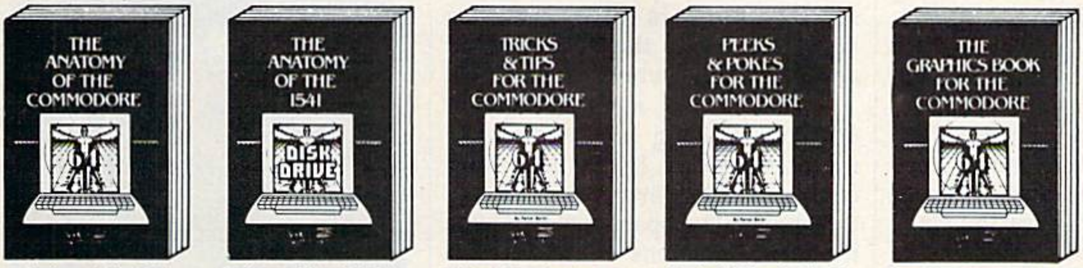

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Color Craft

Cynthia Deville

Use colorful geometric shapes to build your own art. Children will find it especially easy to create pictures with a joystick. For the Commodore 64 with a disk drive.

"Color Craft" is a computer drawing program that makes an artist out of anyone. Even if you can't draw a straight line, you can use the available array of circles, rectangles, and triangles to create images full of bright colors on your computer screen.

Color Craft is comprised of two programs. The first is written in BASIC and the second in machine language. First, type in Program 1, the BASIC program, and save a copy to disk. Then type in Program 2, the machine language program, using "MLX," the machine language entry program found elsewhere in this issue. When you run MLX, you'll be asked for the starting address and ending address of the data you'll be entering. For Color Craft, reply with the following values:

Starting address: C000
Ending address: CBCF

Be sure to save the machine language program with the name COLOR CRAFT.OBJ so the BASIC program can locate it on disk. To use Color Craft, load and run Program 1. It, in turn, will load and execute the machine language program.

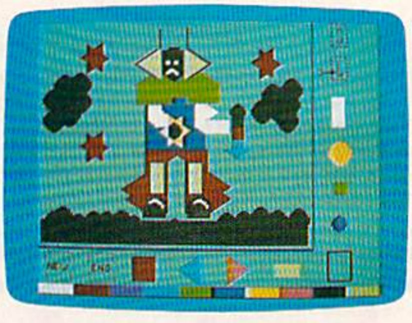
Crafting Your Picture

When the black arrow appears, Color Craft is ready. Use a joystick plugged into port 2 to control the arrow. First, select the color you wish to use by moving the arrow to the appropriate color bar at the bottom of the screen and pressing the joystick button. The screen border turns to the color that you choose. Now, select the shape you wish to draw with by pointing the black arrow to the appropriate shape and pressing the button. A shape in the color you selected appears in the drawing area. Move it to the desired place and press the button to place it.

The joystick moves relatively quickly, allowing you to traverse the screen easily. If you need finer control, use the cursor keys to move the shape. The space bar performs the same functions as the joystick button.

In addition to the various shapes, you can also select the eraser, which is the outlined square in the bottom right corner of the screen. It wipes out anything within its borders, changing it to the background color.

There are two special boxes in the upper right corner. One, the S box, is used to save the pictures you've drawn to a disk. The other, the L box, is used to load pictures from disk. When asked for a name, type in a valid filename. It's a good idea to give all of your pictures a common extender so that you can identify picture files (for example, FLYING FISH.PIC).



It's easy to construct pictures from the geometric shapes that "Color Craft" provides. The stars were created with two overlapping triangles.

In this picture, the sun and clouds were built with different colored circles.

The NEW box erases the entire drawing area. If you wish to save the work on the screen, be sure to save your picture before selecting NEW.

Selecting the END box returns you to BASIC. Type RUN to restart Color Craft.

See program listings on page 101.

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The Commodore 1670 Modem

After telecommunicating at 1200 baud, you'll never go back to 300. You spend less time online and get a lot more done.

Downloads are four times faster. For example, what would take ten minutes at 300 baud takes only two to three minutes with the 1200-baud 1670 modem from Commodore. A large file that would take 30 minutes with a 300-baud modem takes only seven to eight minutes with the 1670. Reading through messages and electronic mail is also quite fast. On menu-based systems, the lists of options almost splat onto the screen. Without a doubt, 1200 baud makes telecommunicating more enjoyable than ever.

For years, the best Commodore software has come from third-party developers. And, generally, Commodore is better known for its hardware than its software. Nowhere is this more true than in the field of telecommunications. I've used most of Commodore's other modems: the 1600 VICModem, the 1650 AutoModem, and the early version of the 1660 Modem/300. Each modem was packaged with a bare bones terminal program that wasn't meant to do much more than get you online. None of them included XMODEM, CIS-B, or Punter—the three most popular protocols for telecommunications. If your terminal software doesn't support any protocols, you can't upload or download programs. About all you can do is read messages and respond to them.

You'll regularly see messages about downloading problems on the national telecommunications services and local bulletin boards. The standard reply to people who have a 1600, 1650, or 1660 is this: Your modem is fine; you just need to get a better terminal program, one that supports downloading. But there's a Catch-22: You can't download until you have a terminal program with a protocol and you could easily download such a program except that you need a protocol to download it. You can't get it online unless you already have it.

In packaging the 1670, Commodore included not just one good terminal program, but four: The *QuantumLink* program, *Common Sense*, *VT-52* for the 64, and *VT-100* for the 128. All are full-featured, powerful terminal programs. Three of the four support downloading protocols.

The *QuantumLink* program is a system-specific terminal program. It works only on a 64 (or 128 in 64 mode) and only on the QuantumLink telecommunications service. In addition to the terminal program, you get an information pamphlet that explains QuantumLink and a password for logging on to the system.

It's heartening to see a Commodore modem that comes with a set of useful terminal programs for both the 64 and 128.

For most other purposes, you'll need to use the *Common Sense* software. It contains all the terminal features you'd want, including support for both XMODEM and CompuServe-B protocols, so you shouldn't have problems downloading. If for some reason you don't like *Common Sense*, you can use one of the built-in protocols to download another terminal program from a service. If you like *Common Sense*, the 1670 package includes an order form for *Sixth Sense*, a more powerful, programmable version of the the same terminal program.

For 128 owners who use an 80-column color or monochrome monitor, the VT-100 program is recommended. It supports XMODEM protocol and ASCII transfer (with or without translation from true ASCII to Commodore ASCII). If you forget one or more of the commands, just press the HELP key to see four menus that list the available options. It also sports an attractive custom character set that's easier to read than the standard 80-column character set.

You probably won't use the VT-52 program unless you need to communicate with a DEC VAX computer at school or at the office. It doesn't seem to support any downloading protocols, although it does have a software-supported 80-column screen for the 64 which is interesting.

It's heartening to see a Commodore modem that comes with a set of useful terminal programs for both the 64 and 128. There's no program for the Plus/4, although there is a provision for setting one of the DIP switches on the back of the 1670 if you own that computer and can find a terminal program for it.

I've used the 1670 with a variety of other terminal programs for the 64, 128, and 128 in CP/M mode. It works fine with all terminal programs I've tried.

At one time, most national telecommunications services had a two-tier price system for 300 and 1200 baud. As competition among the services has grown and the number of 1200-baud modem users has increased, the two-tier system has largely disappeared. You pay the same price for both 300 and 1200 baud on services such as Delphi, GEnie, PlayNet, and QuantumLink. On People/Link and the Source, you pay an additional dollar or two per hour. CompuServe still maintains two prices ($6.25/hour for 300 baud, $12.50 for 1200 baud).

You can find 300-baud modems that cost $20–50. The list price of the 1670 is $149.95, although it's often sold at discounted prices. The price you pay for 1200 baud is roughly $100 more than the price for 300 baud. Is it worth it? Let's say you spent a total of 20 hours over a period of several months downloading programs at 300 baud. Since 1200 baud is four times faster, you'd save 15 hours of connect time if you used the 1670. At $4–$10 per hour, the savings amounts to roughly $60–$150. In the long run, for people who like to download a lot of programs, the higher price might be justified. On the other hand, if you spend a couple of hours each week in the conversation area (sometimes called conference, CB, or the people connection), 1200 baud won't reduce your connect time. Two

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*The Commodore 64 Pascal interpreter is not full-featured, but still a powerful implementation of Pascal which suits the needs of most beginners.

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hours of conversation is two hours, regardless of whether you're using 300 or 1200 baud.

There's also the intangible factor of convenience. At 1200 baud, you spend less time waiting for menus and downloading. I'd never go back to 300 baud.

—Todd Heimarck

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Alter Ego And Mind Mirror

How well do you know your own personality? Are you shy? Cheerful? Domineering? Have you ever wished to be someone else? Or to have other personality traits? How would you handle a crisis?

Two new programs for the Commodore 64 help you answer and explore these questions. *Alter Ego* and *Mind Mirror* let you run away with your innermost thoughts. *Alter Ego*, from Activision, purports to be the game of life, letting you experience life's decisions and choices over again or for the first time. *Mind Mirror*, from Timothy Leary and Electronic Arts, aims to be part game, part tool, and part philosopher as it helps users understand personalities better—both their own and others'. Both programs emphasize the human personality and its reactions to the world around it.

Alter Ego is "a fantasy role-playing game about life" that lets you try those "what ifs" of life. What if your childhood had been different? What if you had that major decision to make over again? The program recreates these and other situations for you as you experience decisions and choices from various stages of life.

The theme of the program lies with human personality in a broad sense. *Alter Ego* is flexible in this regard—you may choose from your own personality, a random personality created by the program, or a custom personality fashioned by you. *[Ed. Note: There are male and female versions of Alter Ego available.]* You establish the personality that you will use by answering a series of true/false questions. By answering the questions honestly about yourself, you select your own personality for use. By answering them differently from the way you would answer the questions yourself, you establish a unique personality.

Once your personality is established, *Alter Ego* asks where in life you want to start. The game divides life up into seven stages, ranging from Birth

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and Infancy to Old Age. Obviously, the life experiences and choices you are presented with will differ depending on the stage at which you start. These experiences and choices are presented on a "map" with icons representing several categories, separated generally into two areas: life experiences and life choices. Life experiences include social, intellectual, emotional, familial, physical, and vocational areas. Life choices focus more on major decisions such as college, marriage, major purchases, and relationships.

You start on the life map at the bottom and work your way up by experiencing life or making life decisions. Each experience and choice you make increases your age, experience, and maturity. While many experiences and choices may be skipped along the way, others must be undertaken in order to make choices in subsequent life experiences. This is particularly true in the early life stages because of your personality's lack of experience and capabilities. At any time, you can check your age and how your personality is doing in 12 different categories, such as confidence and intelligence. Before entering the next stage on the life map, you receive a detailed personality "health" report. You can save games either between or at the end of a life stage.

Results of a life experience or life choice critically hinge on the personality you have employed. As a matter of fact, the most disappointing aspect of the program is that your options on the life map are limited and many times you end up just reading what happens. Most of the time you are only presented with two or three decision options and often only one course of action is characteristic of your personality. The key to getting what you want out of *Alter Ego*, then, is to take care in choosing the personality profile.

The program comes on three disks. A brief but sufficient manual gets you into the program quickly. The manual goes out of its way to disclaim that the program is anything but a game for your entertainment. While *Alter Ego* entertains, by permitting you to fantasize—and its textual responses can be very amusing—the program is much more than a game. In fact, I would classify it more of an educational program because of the insights it provides into personality and human actions and reactions.

Is it fun? Well, it's not a fast-paced arcade game, but rather a program that puts your mind to work and makes you learn a little about life and people. If you enjoy living and learning, you will enjoy *Alter Ego*.

To a greater extent than *Alter Ego*, *Mind Mirror* delves into human personality. This program goes about its exploration, however, in a different manner. Dr. Leary's program employs pie charts called "mind maps," which gauge your chosen personality according to 16 attributes. The attributes include charisma, arrogance, dominance, submissiveness, and anger. The mind maps look like dartboards, and display your personality's rating for each attribute. The closer the attribute rating is to the outer edge of the pie chart, the stronger that attribute is manifested in the personality. The attributes are arranged on the chart to correlate with each other, so that the location of the rating for one attribute shows tendencies of other attributes.

In similar fashion to *Alter Ego*, *Mind Mirror* gives a lot of flexibility in choosing a personality to use in the program. You can use your own personality, your favorite celebrity's, or a custom profile created by you. However, instead of asking true/false questions like *Alter Ego*, *Mind Mirror* requires you to rate the subject personality on its attributes.

Alter Ego and *Mind Mirror* let you run away with your innermost thoughts.

This is accomplished using questions concerning the attributes and answering the questions by rating the personality on a scale ranging from never to always. An example phrase of such a question would be "nervous at big parties." You would rate your subject according to whether he or she would always, often, sometimes, seldom, or never be nervous at a big party. Once you've run through the ratings, the mind maps are available for review to see how the personality's attributes appear.

From that point, *Mind Mirror* takes you through exercises that seem to test your ability to figure out how your chosen personality will respond or react to the exercises or situations presented. You can examine a personality's opinion on various subjects from religion to politics, or you go through life simulations similar in concept to *Alter Ego*. Again, you use a rating system in response to the program prompts, which are later compared to the personality's attribute ratings on the mind maps. The objective is to try to respond to the exercises or simulations as your personality would, and, accordingly, have your responses produce a mind map identical to the mind map of the personality profile.

However, the genius of the program is the insight the user gains from setting up the personality profile and going through the exercises—the user is testing his or her own perceptions. First, a subject's profile is chosen for examination. But that subject's personality traits are determined by the user. Therefore, the subject's attributes are not necessarily true attributes, but rather the user's perception of the personality attributes. Furthermore, the exercise is really a self-test or quiz on the user's own perceptions, which results in both subtle and astonishing revelations for the user about his or her own personality.

The program adds depth to its enjoyment by offering several levels of play, progressively reducing the amount of prompts and "coaching" you receive. Also, *Mind Mirror* can be played by groups or teams, making it an interesting party game. Dr. Leary even has made provisions in the program for its use by professionals in their treatment of individuals and groups.

Mind Mirror comes on two disks, with the 2000 available life simulations on both sides of one of the disks. The manual is informative, interesting, and brief. It does not, however, need to be very involved because of the nature of the program and the amount of onscreen prompting and aids. The manual does give you some interesting background into the evolution of human thought, or at least Dr. Leary's theory of human thought. Also, the manual contains an interview with Dr. Leary on the program, psychology, and life in general.

In summary, both *Alter Ego* and *Mind Mirror* are entertaining and insightful. Both are provocative and amusing, and will surprise users with their depth and complexity. They are excellent examples of a serious nonbusiness application for the home computer. To top it off, you just might learn a lot about your own personality.

—Scott Thomas

Alter Ego
Activision
2350 Bayshore Frontage Rd.
Mountain View, CA 94043
$49.95

Mind Mirror
Electronic Arts
1820 Gateway Dr.
San Mateo, CA 94404
$32.95

Trinity

Trinity is the latest in a long line of successful and high-quality text adventures from Infocom. Infocom has earned an excellent reputation for "interactive fiction," where the program user becomes the central character in a fictional story that unfolds as the user reacts to circumstances presented in the story. *Trinity* follows the Infocom tradition of high quality and excellence, but is unique to Commodore users in that it is exclusively for the 128 mode of the Commodore 128 and requires an 80-column monitor. The depth, complexity, and flexibility of *Trinity* apparently made the program's memory requirements too large for the Commodore 64. As a 128 owner, I was glad to see Infocom's support of the 128, but *Trinity*'s inability to run on a 40-column monitor will exclude many 128 owners who have not acquired or upgraded to a monitor capable of displaying 80 columns.

The program comes on a single two-sided disk that will load on a 1541, 1571, or compatible disk drive. Side 1 of the disk is loaded first; you are then prompted to "flip" the disk over to finish loading the program. Because *Trinity* does not take advantage of the double-sided storage capacity of the 1571 disk drive, Commodore 128 owners who have single-sided 1541s will be able to run the program.

Once the program is loaded, you are thrust into a world where fantasy and reality coexist. *Trinity* provides you with two objectives. Your preliminary objective is to survive a nuclear holocaust. *Trinity*'s story begins with your character on vacation in England. While you're minding your own business and touring London's Kensington Gardens, World War II breaks out and world destruction is imminent. Your only hope of survival is to not be there when it happens. But how does one escape world destruction? In *Trinity*, you escape by entering a new time, place, and dimension.

Once you've succeeded in discovering the escape route from Kensington Gardens, you are thrust into a strange new place reminiscent of Alice's Wonderland, with giant toadstools filling the landscape. From this strange new land you embark on a quest. With no explanation of how to accomplish the goal, the primary objective in *Trinity* is to alter the history of the development of the atomic bomb. As you work to accomplish your goal, your intelligence and ingenuity will be put to the test with the curious new universe in which you are placed and its challenging and perplexing puzzles. I found the most unique aspect to the *Trinity* universe was that its shape is what is known as "Klein bottle" or "Mobius strip," which is one of those curious solid shapes that has no sides. In a universe with a "Klein bottle" shape, if you moved in one direction long enough, you would end up where you began. In *Trinity*, this results in some very confusing navigation, as you instruct the program to go east, but actually end up going west.

As you work to accomplish your goal, your intelligence and ingenuity will be put to the test with the curious new universe in which you are placed and its challenging and perplexing puzzles.

The quest to obtain your goal reaches truly epic proportions, as you travel through time and space to certain times and locations key to the development of the atomic weapon. If you are cunning enough, you'll wind up in the New Mexico desert, minutes before the culmination of the greatest scientific experiment of all time: the world's first atomic explosion, code-named Trinity.

The program comes with several "props" to both add to the atmosphere and realism of the story, and to provide hints and clues to help you on your quest. The props include *The Illustrated Story of the Atomic Bomb*, a somewhat amusing and satirical comic book on the A-bomb; a map of the Trinity site; a cardboard sundial; and instructions on how to make a paper bird (a crane). The instruction manual is well written and provides many helpful examples and explanations, particularly to text-adventure novices. *Trinity*'s parser is complex and flexible, permitting a much smoother and friendlier approach to communicating your commands. The program boasts a vocabulary of over 2000 words and permits fairly complex sentence syntax. The user can put several objects with certain verbs in a single command by separating the objects with the word *and* or by a comma. Further, you can put several sentences on one command input line if you separate each sentence by a period or the word *then*. I found communicating my commands to *Trinity* easier and less intrusive to playing the game than with any other text adventure I have played before, including previous Infocom titles.

Since *Trinity* will take several hours to complete, and even longer to fully explore all of its universe, the program allows you to save your position and restore to that position at a later time. You are allowed to save up to four different game positions per data disk. Saving your position can be strategic in the game, particularly when you are about to embark on a dangerous action which may threaten your life and continued involvement in the story. By saving your position just prior to taking such action, you can return to the place just prior to that action without having to start from scratch.

Trinity has several special commands, permitting you to vary the length and detail of descriptions and dialogue the story provides. Also, if you accidentally mistype a word, you can use the Oops command to correct the mistyped word without having to completely reenter the previous command. Finally, the Script and Unscript commands permit you to make a hardcopy of the story as it unfolds with your printer. *Trinity* will work with Commodore printers or printers that can emulate Commodore printers.

Bryan Moriarty, author of *Trinity* and the previous Infocom title *Wishbringer*, did an excellent job of making such a curious blend of fantasy and reality meld into an intriguing new universe. The dialogue in *Trinity* is well written and often very amusing. The only time the dialogue is puzzling or confusing is when it is intended to be so. Prior to seeing *Trinity*, I was somewhat disappointed to hear that Infocom had not added graphics to its text adventure, particularly since it was utilizing the larger memory of the Commodore 128. However, Infocom stuck to what it knows best, a pure text adventure, and the program does not lack for excitement. The descriptive dialogue in *Trinity* invokes one's imagination to visualize the *Trinity* universe, similar to the way a good book does for its readers. Therefore, after having explored *Trinity*, I believe Infocom made the correct choice to leave graphics up to the user's imagination.

All in all, *Trinity* is a first-quality text adventure that will entertain and challenge its users. The program, as with all good interactive fiction, was more addicting to me than arcade-style games, as I discovered myself spending much more time engrossed in *Trinity* than intended. Both newcomers to interactive fiction and experienced players will find *Trinity* enjoyable and well worth the purchase price.

—Scott Thomas

Infocom
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RAM Expansion For The Commodore 128

Jim Butterfield

Commodore's new RAM-expansion modules greatly increase the power of the 128. Although software that exploits these devices hasn't yet appeared, there are still many ways you can put the modules to work. This article shows some of the principles of operation and hints at the astonishing flexibility of the new expansion devices.

The new Commodore RAM expansion modules—the 1700 with 128K, and the 1750 with 512K—each come with a manual and a *Test/Demo* disk, but these only hint at the capabilities of the devices. These expansion modules are able to hold a wide variety of information—screens, programs, or data—and can transfer them to and from the 128's main memory very, very quickly.

Ground Rules

The memory of the expansion units is volatile, just like the rest of the RAM in the system. This means that when the power goes off, the information is lost. Keep in mind that you get extremely fast, but temporary, storage.

The 1700, with 128K of storage, has a capacity of about two-thirds that of a single-sided Commodore disk. The 1750, with a whopping 512K, can hold more information than a doubled-sided 1571. When the proper software finally becomes available, the 128 will become an even more powerful computer system.

Both the 64 and the 128 have been hampered by the limited capacity of a single disk drive. To copy a disk, you must bring part of its contents into the computer's memory, write out that part to the target disk, and then repeat the procedure until everything has been copied. Some files are too big to fit completely into the computer's main memory, and must be handled piece by piece. Sometimes this is merely an inconvenience, but some serious business applications—such as sorting—are severely hampered by such limitations. The traditional solution was multiple disk drives. A new solution is RAM expansion.

For CP/M, the memory-expansion units are immediately useful (for more information, see "Using RAM Expansion with CP/M," accompanying this article). The CP/M operating system is "disk-resident"—most tasks the user wants to do are called in from disk as they are needed. This contrasts with the 64 and 128 modes of the 128, where most operating system tasks are in ROM and are instantly available. CP/M users notice many pauses as various utilities load in.

The memory-expansion unit looks like another disk drive to the CP/M system—but a very fast one. The pauses for disk loads vanish. If the user sets up the system correctly, the expansion unit speeds the needed code into place almost instantaneously. Those annoying little hesitations vanish.

The 64 and 128 modes don't yet have a comparable disk emulator. To use these devices, you'll need a program to do the job. There's already a copying utility ("Unicopy 128") available for simple file copying, and more programs are sure to come.

In the meantime, this article shows you some of the techniques—and some of the possibilities—that the RAM-expansion devices bring into play. The simple BASIC 7.0 programs given here work on either of the RAM expanders.

By the way, even though the connector looks compatible, *don't* try to plug either of the modules into a Commodore 64. The power supply isn't able to handle the load, and you're likely to cause electrical damage to the chips on the board.

In the following programs, we'll use the following BASIC 7.0 statements:

STASH (to save information to the expansion unit)
FETCH (to recall information)

The SWAP statement—which I don't use in this article—allows data to be exchanged between the computer's main memory and the expansion device.

Each statement is followed by four numbers:

- number of bytes to transfer
- main memory address
- expansion memory address (0–65535)
- expansion memory bank (0–1 for the 1700 or 0–7 for the 1750)

Screen Animation

The *Test/Demo* disk comes with some very pretty high-resolution animation programs. To save space and time, we'll do something much simpler in BASIC:

```
100 REM ** MAKE SEVERAL SCR
    EENS AND
110 REM ** PUT THEM IN RAM
    {SPACE}EXPANSION
120 BANK 15
130 PRINT CHR$(147)
140 PRINT:PRINT
150 M$="HELLO THERE......."
200 A=0
210 FOR J=1 TO LEN(M$)
220 STASH 1000,1024,A,0
230 A=A+1000
240 PRINT MID$(M$,J,1);
250 NEXT J
260 STASH 1000,1024,A,0
270 B=A
```

So far, we've cleared the screen and printed a simple message one character at a time. With each character, we've saved (STASHed) the whole screen to expansion RAM. The screen is 1000 characters long, and begins at location 1024 in system memory. As we STASH each screen, we add to the value of variable A, the address in expansion memory at which we'll put the next screen.

Now for the fun part. We'll bring back these screens—in any desired order—for some fast animation:

```
300 REM ** PRINT SCREENS IN
    FORWARD
310 REM ** AND REVERSE ORDE
    R
320 FOR J=1 TO 50
330 FOR A=0 TO B STEP 1000
340 FETCH 1000,1024,A,0
350 NEXT A
360 FOR A=B TO 0 STEP -1000
370 FETCH 1000,1024,A,0
380 NEXT A
390 NEXT J
```

See how we FETCH the screens back as we need them? And you'll notice how quickly it all happens. It's a simple example, but it lets you see how STASH and FETCH work.

Program Storage

One of the most promising features of RAM expansion is the possibility of calling in machine language programs quickly and executing them. Dozens of small programs could be waiting in expansion RAM. When needed, they could be put into place and run. No need to worry about how to fit all those programs into memory—they could be called in as required.

A simple example shows how it works. We'll use BASIC to put two machine language programs into the RAM expansion. The first prints the word *RED;* the second prints the word *YELLOW.* We could work all this into one program, of course, but that wouldn't demonstrate the possibilities. Type NEW and try this:

```
50 REM ** PLACE TWO DIFFERE
   NT PROGRAMS
60 REM ** INTO RAM EXPANSIO
   N
80 BANK 15
100 DATA 162,0,189,14,11,32
    ,210,255,232
110 DATA 224,4,208,245,96,8
    2,69,68,13
120 FOR J=2816 TO 2833:READ
     X:T=T+X
130 POKE J,X
140 NEXT J
150 IF T<>2114 THEN STOP
160 STASH 18,2816,0,0
```

That puts the first (RED) program into RAM expansion. Now the second one:

```
200 DATA 162,0,189,14,11,32
    ,210,255,232
210 DATA 224,7,208,245,96,8
    9,69,76,76,79,87,13
220 FOR J=2816 TO 2836:READ
     X:T=T+X
230 POKE J,X
240 NEXT J
250 IF T<>4488 THEN STOP
260 STASH 21,2816,18,0
```

Notice that we STASH the second program into a different location in expansion RAM—we don't want to write over the first one. Now we'll add the statements needed to call back and execute them:

```
300 REM ** SWITCH BETWEEN T
    HE TWO
310 REM ** MACHINE LANGUAGE
     PROGRAMS
400 FOR J=1 TO 5
410 FETCH 18,2816,0,0
420 SYS 2816
430 FETCH 21,2816,18,0
440 SYS 2816
450 NEXT J
```

Again, a simple program. But you can see the principle involved—and the potential power.

BASIC Program Overlay

Can a BASIC program bring in another BASIC program from expansion RAM? Yes, but it requires great care if you want to do it purely in BASIC. The new program must synchronize very closely with the old one.

Type NEW and enter the following program:

```
100 A=PEEK(45)+PEEK(46)*256
110 BANK 0
120 FETCH 2000,A,2000,0
```

After the final instruction in this section of the program is executed, the new program will be in place. Thus, the code that follows will not run, since it will be replaced by a new program.

```
130 PRINT "THIS IS A SAMPLE
     PROGRAM"
140 PRINT "THAT WILL BE LOA
    DED IN"
150 PRINT "BY ANOTHER PROGR
    AM"
160 PRINT
170 PRINT "BY THE WAY..."
180 PRINT "THE ROOT OF";J;"
     IS";K
185 IF J>=20 THEN END
190 GOTO 100
```

The statements above seem curious: How can we print the values of variables J and K when we've never calculated them? The answer, of course, is that another program will calculate these values for us.

The lines below are not part of the main program. They put the whole program into expansion RAM.

```
200 A=PEEK(45)+PEEK(46)*256
210 B=PEEK(4625)+PEEK(4625)
    *256
220 BANK0:STASH B-A,A,0,0
230 BANK 15
```

The value of A is the address where your BASIC program starts. Normally, that's 7169. The value of B is the address of the first unused byte following the program. So the size of the program is B−A, and that's the number of bytes we will STASH. The address from which we will STASH is held in A.

Do not run this program yet. Instead, type RUN 200 and press RETURN to STASH the program into the expansion module.

We're ready for the second program. Before you type NEW to erase the first program, enter the following:

```
LIST -129
```

Now type NEW and move the cursor back to the first of the three lines that were displayed by the list. Reenter the lines by typing RETURN on each line, but note that there is a change to line 120:

```
100 A=PEEK(45)+PEEK(46)*256
110 BANK 0
120 FETCH 2000,A,0000,0
```

Using RAM Expansion With CP/M

Todd Heimarck, Assistant Editor

CP/M has only five built-in commands. The rest are *transient* commands, meaning they reside on disk. To copy a file from one disk to another, for example, you must first insert the disk containing PIP.COM into the disk drive and type PIP at the A> prompt. Once the command is in memory, you can copy files back and forth between disks. A shortcut is available: You can provide the filenames when you load the command (PIP B:BACKUP.COM =A:LIFE.COM for example).

Because CP/M is a disk-intensive operating system, a slow drive will cause annoying delays. If you own a 128, you can run CP/M with a 1541, but you'll find disk access very sluggish. A 1571 is preferable for three reasons: It's faster, the disks can hold twice as much data (320K versus the 1541's 160K), and it can read other CP/M formats, such as Osborne, Kaypro, and Epson.

A Superfast Disk Drive

The fastest disk drive of all, however, is a 1700 or 1750 RAM expander operating as a RAM disk. A 1541 or 1571 is mechanical; the disk spins, a read/write head moves back and forth over the surface, and bits are transferred over the serial cable. The time it takes to read or write a file is limited by the speed of the mechanical parts in the drive. Memory, on the other hand, is almost instantaneous. The Commodore RAM expanders transfer data at one megabyte per second, so a 64K program loads in 1/16th second, many times faster than a 1571.

Since any program or command will load in a fraction of a second, the time it takes to read a disk is no longer a problem. After booting CP/M, you can copy all your favorite utilities to the RAM disk, which operates as drive M. Type the following lines (which assume that PIP.COM and other useful programs are on the utility disk in drive A):

```
pip m:=a:pip.com
m:
pip m:=*.*
```

The first line copies the PIP program to drive M (the expander). The second changes the default drive to M (after you've pressed RETURN, the A> prompt will change to M>). The final line uses wildcards to copy all files from drive A to drive M.

To make things even easier, you can use a word processor or line editor to type the three lines above into a file named PROFILE.SUB and copy it to your boot disk. You must also put a copy of SUBMIT.COM on the disk. When the system boots, the commands in PROFILE.SUB will automatically execute, and all the files on the disk will be copied to the expander.

With your favorite utility commands and programs in the RAM disk, you can call up any one of them almost instantaneously.

Help Is A Keypress Away

The Commodore 128 CP/M disk contains a program called HELP.COM. To run it, just type HELP (with the proper disk in the drive) and then type the commands or topics about which you want to learn more. The public domain terminal program *Modem Executive* (MEX.COM) and Kamasoft's program *OutThink* also support the HELP command. Sometimes you can access the help file by pressing the gray HELP key.

These help files are useful when you've forgotten the details of a certain command. But they're all disk-based files, and sometimes it takes ten seconds or more to find the file and display it on the screen.

If you PIP the program and the help files over to the RAM disk, the time savings are significant. Press the HELP key and the information you need is instantly there.

Fast Backups

If you own two disk drives, making backup copies of disks or programs is relatively fast. To back up a whole disk from A to B, use PIP B:=A:*.* and PIP takes care of the rest. It's not as easy with a single drive. You're forced to use the virtual drive E (the computer's memory). If you PIP E:=A:*.*, you'll have to follow the prompts (INSERT DISK E, then INSERT DISK A, INSERT DISK E, and so on). It's quite a time-consuming process.

Again, the memory expander can speed things up. If you have a single drive plus the 1700 or 1750, you can PIP all the files from A to M, switch disks, and PIP them from M to the new disk in A.

Downloading And Debugging

There are thousands of public domain CP/M programs available. Many can be found on remote CP/M (RCPM) bulletin boards throughout the country. Most RCPM boards are free or charge a modest membership fee.

Cost becomes a factor when you consider that you generally have to call long distance to access an RCPM board. The longer the call takes, the higher your long-distance phone bill. One way to speed up downloads is to use a 1200-baud instead of 300-baud modem. Since the data transfers four times as fast, less time is needed to download (and the lower your phone bill). The speed of your disk drive also makes a difference. If you download to disk, the terminal program will pause now and then to write the file to disk. This leads to delays that add to the connect time.

Downloading to a RAM disk cuts down on long-distance charges. You can download a file directly to memory, log off, and copy the file to disk without paying extra for the time it takes to write to disk.

The RAM expanders also help if you're writing programs in a compiled language. Languages such as C and Pascal (some of which are in the public domain) are available for CP/M. But most are compiled languages, which means that you have to load a word processor or line editor, type in the program, save it to disk, exit the editor, and run the compiler to create a program. If there are errors, you reload the editor and the source code, make the change, recompile it, and so on.

If you're trying to track down an elusive bug, it takes time to switch back and forth between the editor and compiler. If you have a RAM disk, the loading time is unnoticeable.

One final advantage of using a RAM disk is its size, especially if you have a 1750. Its 512K of available memory is bigger than a double-sided 1571 disk. With large amounts of memory, the fast access time, and a program like *Turbo Pascal* or *dBase II*, CP/M on the 128 gives you a powerful computer system.

When the program reaches this point, it FETCHes the first program we typed. That's why we did this careful reentry of the first three lines; we wanted these lines to be exactly the same size as in the first program, so that the code synchronizes correctly.

```
130 PRINT "<CALCULATING>"
140 J=J+1:K=SQR(J)
150 GOTO 100
```

The above code isn't too exciting, but it does calculate values for J and K to be used by the other program. Continuing with our STASHing code:

```
200 A=PEEK(45)+PEEK(46)*256
210 B=PEEK(4624)+PEEK(4625)
    *256
220 BANK0:STASH B-A,A,2000,
    0
230 BANK 15
```

Again, don't run this program right away. STASH it by entering RUN 200. You may now bring back the first program with the following:

BANK 0:FETCH 2000,A,0000,0

Now that both programs have been safely STASHed and the first program has been retrieved, you can type RUN. It's impressive to see how quickly the two programs switch places.

By the way, I've assumed that the programs will be smaller than 2000 bytes in size. That's a pretty safe assumption in this case. If you're handling larger programs, be sure to allow enough room.

Note that we use a BANK 0 statement before the STASH or FETCH. That can be important. Bank 15, the computer's default configuration, only includes RAM up to address 16383; above that, ROM is seen in that configuration. A program whose size exceeds 9K will not STASH or FETCH correctly unless you use the BANK 0 statement to make the RAM where the program is stored visible.

STASHing Data: Special Considerations

STASHing and FETCHing variables and arrays can be a very powerful technique, but a special gimmick is required. Variables and arrays are kept in block 1 of the 128's two blocks of RAM; that's separate from the block 0 of RAM that holds your program text. But you don't get the STASH or FETCH statements to transfer data between RAM expansion and block 1 RAM simply by using a BANK 1 statement.

To transfer data between RAM expansion and block 1 of system RAM, you must set a bit in the MMU (Memory Management Unit) chip that determines which system RAM block will be used for VIC chip memory and other DMA (Direct Memory Access) operations. You need to switch the bit only for the brief period in which you do the STASH or FETCH, but it must be done, even if you're using 80-column video instead of the VIC chip's 40-column display.

The following program switches the MMU register for block 1 access with POKE 54534,68, and restores it to block 0 with POKE 54534,4. If you're working in 80 columns, you won't see a thing. If you're using the 40-column screen, however, the screen will be a mess for the brief period of time that the switch is in effect. It's just a flicker, but if it bothers you, you can always turn the video off or even set up a message screen in bank 1 to give a neat display (see "Video Setup" in the January issue.)

In the following examples we'll STASH and FETCH both variables and arrays. But we won't play with strings. Because string lengths can vary, the job gets tough; it's more a task for machine language programmers.

Saving Variables

Type NEW and enter the following lines:

```
100 J=1234:K=J+1
200 BANK 15:POKE 54534,68
210 BANK 1:STASH 5,POINTER(
    J),0,0
220 BANK 15:POKE 54534,4
```

We've given values to J and K, and then we've STASHed the value of J. Lines 200 and 220 switch the system RAM access to block 1 and back to block 0, and line 210 does the STASH. J is a floating-point variable; its value is held in 5 bytes. The location of variable J in memory is determined using the BASIC 7.0 POINTER function.

```
300 J=7:K=J+1
400 BANK 15:POKE 54534,68
410 BANK 1:FETCH 5,POINTER(
    J),0,0
420 BANK 15:POKE 54534,4
600 PRINT "J=";J;"K=";K
```

Now we put different values into J and K, and then FETCH back the previous value of J. Run the program and see how quickly it does the job. You might like to change the coding so that J's former value is FETCHed back into variable K.

Arrays

When STASHing and FETCHing arrays, you'll need to be careful about a few things.

Arrays can move. If a new variable is defined, memory is moved up to make room. Be sure to use the POINTER function each time you STASH or FETCH an array; it might not be at the same location where you last saw it.

Don't forget that all arrays start numbering at 0. For example, you want to STASH a couple of arrays that have been dimensioned as DIM A(10),B(5,5). Allowing for five bytes per element, you might think that the data will occupy 50 bytes and 125 bytes respectively. Instead, the correct values are 55 (11 × 5) and 180 (6 × 6 × 5). Thus, to save array A you would use STASH 50, POINTER(A(0))....

You can STASH from one array and FETCH the data back to another. Unless you are very familiar with Commodore internals, be sure the two arrays are the same size.

Now for an example. Type NEW and enter the following program:

```
100 DIM X(11)
110 FOR J=0 TO 11:X(J)=J*J:
    NEXT J
200 BANK 15:POKE 54534,68
210 BANK 1:STASH 60,POINTER
    (X(0)),0,0
220 BANK 15:POKE 54534,4
```

We've created an array of squares of values. Off goes the whole array into RAM expansion. The number of bytes is 60 (5 × 12).

```
300 FOR J=0 TO 11:X(J)=SQR(
    J):NEXT J
310 K=X(9)
400 BANK 15:POKE 54534,68
410 BANK 1:FETCH 60,POINTER
    (X(0)),0,0
420 BANK 15:POKE 54534,4
600 PRINT "X(9)=";X(9);"K="
    ;K
```

We calculate a brand-new array of square roots. Just to prove it's there, we save one of its values into variable K. Incidentally, the new variable K causes array X( ) to move up seven bytes, but we don't need to worry. A simple FETCH brings back the original table of squares, and the printout proves it.

The RAM-expansion modules are so fast and versatile that they're likely to be of major advantage in large programs. So far there's a limited amount of software available, but keep an eye out for the new era of computing for the 128, with more speed and capacity at your fingertips.

Text Sequencer

Greg Dixon

This easy-to-use machine language routine prints sequential files to the screen 15 times faster than is possible with BASIC—and you can use it from within your own BASIC programs. A demo program which shows how to call the machine language routine is included. For the 64, Plus/4, and 16 with a disk drive.

Sequential files are powerful tools for programmers. They can hold room descriptions for adventure games, recipe data, and a variety of other types of information. Many word processors create sequential files, and it's often useful to read these files from a BASIC program.

Unfortunately, reading sequential files from disk and printing them to the screen is much too slow in BASIC. "Text Sequencer" is a short machine language program that greatly boosts the speed. It quickly reads sequential files and prints them to the screen. As a bonus, you can change text colors and select page breaks by inserting special characters within the text files you wish to display.

Using The Program

Type in Program 1. Since the program consists mostly of DATA statements which must be typed accurately, use "The Automatic Proofreader" program, found elsewhere in this issue, when you enter it. The program works on the Plus/4 and Commodore 16 with the following modifications:

```
CC 20 IFCK<>19467THENPRINT"ERR
      OR IN DATA STATEMENTS.":
      STOP
SK 80 DATA32,210,255,174,246,7
      ,224,3,240,18
PQ 130 DATA 3,173,246,7,141,22
       8,3,201,60,240
```

After you've typed in and saved a copy of the program, load it and type RUN. The program creates a machine language file named TEXT SEQ.OBJ on disk.

Program 2 demonstrates the use of Text Sequencer. Type it in. In lines 80 and 90, replace FILENAME 1 and FILENAME 2 with the names of two sequential files that you have on disk. You should also change lines 50 and 60 to reflect these changes. Note that line 5 is a POKE to change screen color. Plus/4 and 16 users should type in this line instead:

```
5 COLOR 0,1
```

Lines 80 and 90 both include a SYS to the Text Sequencer machine language. When you write your own programs using Text Sequencer, always use channel 2 when opening the file to be read, and remember to append the ,S,R to the end of the filename so the computer knows that you want to read a sequential file. The ML routine closes the channel before control is returned to BASIC.

Suppose you were to write an adventure game in BASIC. If you're planning to use Text Sequencer, you'll need a line like this near the beginning of the program:

```
10 IF A=0 THEN A=1:LOAD"TEXT
   SEQ.OBJ",8,1
```

Make sure that the TEXT SEQ.OBJ file is on the disk before you run your adventure game. If you had a sequential file on disk called ROOM1, you could display it on your screen with a statement like this:

```
2000 OPEN 2,8,2,"0:ROOM1,S,R":SYS 828
```

Creating Sequential Files

Sequential files can be written from BASIC, but the easiest way to create one is by using a word processor which stores documents as sequential files. If you're using *SpeedScript*, COMPUTE!'s popular word processor, you can create a sequential file by printing the document to disk (be sure to *print* the file, not *save* it). For example, if you have some text in memory in *SpeedScript* that you would like to make into a sequential file, type SHIFT–CTRL–P. Select *Disk*, and then enter the filename with which you'd like to save the text.

The following characters perform special functions in Text Sequencer:

/ end of page
< make following text green
> make following text cyan
% make following text white

Insert these characters in the text as desired to make the designated changes. If you wish to pause the printing of the file, press f7.

See program listings on page 104.

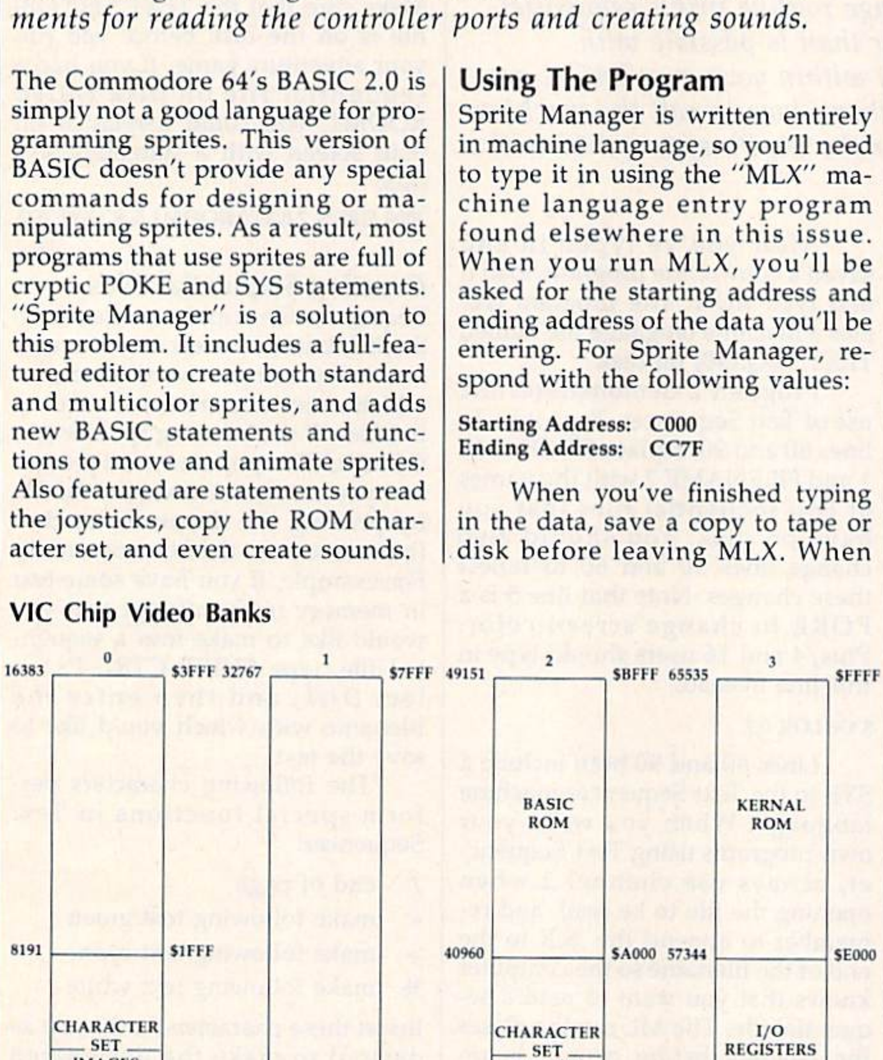
Sprite Manager

Hubert Cross

This sophisticated sprite designer, editor, and animator for the Commodore 64 adds new statements and functions to BASIC that make game design a lot easier. Also included are statements for reading the controller ports and creating sounds.

The Commodore 64's BASIC 2.0 is simply not a good language for programming sprites. This version of BASIC doesn't provide any special commands for designing or manipulating sprites. As a result, most programs that use sprites are full of cryptic POKE and SYS statements. "Sprite Manager" is a solution to this problem. It includes a full-featured editor to create both standard and multicolor sprites, and adds new BASIC statements and functions to move and animate sprites. Also featured are statements to read the joysticks, copy the ROM character set, and even create sounds.

VIC Chip Video Banks

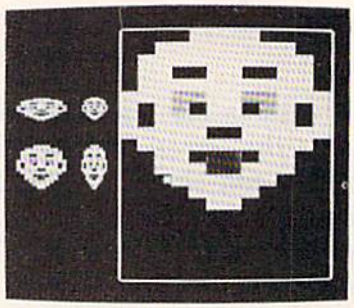


Using The Program

Sprite Manager is written entirely in machine language, so you'll need to type it in using the "MLX" machine language entry program found elsewhere in this issue. When you run MLX, you'll be asked for the starting address and ending address of the data you'll be entering. For Sprite Manager, respond with the following values:

Starting Address: C000
Ending Address: CC7F

When you've finished typing in the data, save a copy to tape or disk before leaving MLX. When



"Sprite Manager" features a flexible and powerful sprite editor. Note the four different sprite sizes shown to the right of the design grid.

you're ready to use Sprite Manager, load the program with a statement of the form LOAD *"filename"*,8,1 for disk or LOAD *"filename"*,1,1 for tape—use the filename with which you saved the data. Then type NEW. Activate the program with SYS 49152. The screen colors will change, and you'll see a message stating that Sprite Manager is active.

If you press RUN/STOP–RESTORE, you'll disable the interrupt-driven statements. Type SYS 49152 to reenable them. Because Sprite Manager uses locations 49152–53247 ($C000–$CFFF), it will not work in conjunction with any other program that uses that area.

Sprites, Banks, And Blocks

Sprite Manager makes sprites easier to create and manipulate, but you still must understand the fundamentals of the 64's video system before you can understand how to use the new statements and functions. There isn't room here for a thorough explanation of sprites. For that information, refer to previous articles in the GAZETTE, and to books like the *Programmer's Refer-*

ence Guide.

Sprites are graphic images that can be manipulated independently of the rest of the screen display. They are generated by the 64's VIC (Video Interface Controller) chip, which provides eight sprites. Each sprite can be displayed in one of two modes: standard or multicolor. Standard sprites are 24 pixels wide by 21 pixels tall, and each one can have a single independent foreground color. (Sprites have no "background" color; any unused pixels in the sprite pattern are transparent, so that whatever is on the screen beneath the sprite will show through.) Multicolor sprites are 12 pixels wide by 24 pixels tall, but appear the same size as standard sprites because each multicolor pixel is twice as wide. Multicolor sprites have three foreground colors instead of just one, but only one of these colors is independent for each sprite; the other two are common to all multicolor sprites.

A 64-byte area of memory known as a *sprite block* is required to define a sprite's pattern. The first 63 bytes of the block hold the definition. The final byte is normally unused, but Sprite Manager uses it to hold information about the type of sprite (standard or multicolor) represented by the pattern. Each sprite has a *sprite pointer* at the end of screen memory that determines which sprite block holds the pattern definition for the sprite. Thus, changing a sprite's shape is as simple as changing the value in its pointer. A common way to animate sprites is to rapidly flip the sprite through a series of pattern definitions. Sprite Manager makes this type of animation very easy to achieve.

One feature of the VIC chip which you must understand in order to use Sprite Manager is the concept of video banks. As its name implies, the Commodore 64 has 64K of RAM memory installed. However, the VIC chip can access only 16K of memory at any given time. For maximum flexibility, the VIC divides the computer's memory into four 16K blocks called video banks (see accompanying figure). Whichever bank is currently selected for the VIC chip must contain all the information for the current video display: screen memory, character patterns, and sprite patterns. The 16,384 bytes available in each bank provide room for 256 different 64-byte sprite definition patterns (numbered 0–255).

One of the biggest challenges of using sprites is finding a place in memory to put their pattern definitions. You cannot use those blocks in the area of memory used for screen memory or character memory, and you must avoid conflicts with BASIC program text and variables. In the default VIC video bank (bank 0), free space is very limited. BASIC and the operating system use most of the memory in locations 0–1023 (blocks 0–15) for working storage. Block 11 (locations 704–767) is free, and you may use blocks 13–15 (locations 832–1023 in the cassette buffer) if your program doesn't use tape. Screen memory normally occupies locations 1024–2047, so blocks 16–31 are unavailable. By design, the VIC chip sees an image of character ROM rather than RAM at locations 4096–12287 (blocks 64–127 in bank 0), so those blocks can't be used for sprites either. Some areas in the other banks are also unavailable. Blocks 64–127 in bank 2 (locations 36864–40959) cannot be used because the VIC chip also sees an image of character ROM in bank 2, and blocks 0–63 in bank 3 (locations 49152–53248) can't be used because that's where the machine language for Sprite Manager resides.

If you store sprite patterns in the area of RAM used for BASIC program text and variables, you must take care that the program and its variables do not conflict with the sprite patterns. You can reserve some of BASIC's workspace by changing the value in location 56 and then performing a CLR to reset other memory pointers. The value in location 56 is the high byte of the address of the first location beyond the BASIC workspace. Location 56 normally holds 160, so BASIC workspace normally extends to address 40960 (160 * 256), the first address of BASIC ROM, but you can reduce this value to create a safe area for sprite patterns. For example, if your BASIC program isn't too long, you can add the line **POKE 56,48:CLR** to the beginning of the program to reserve sprite blocks 192–255 in video bank 0 (locations 12288–16383). This reduces the amount of memory available for your program *and its variables* to 10,239 bytes. Sprite Manager also allows you to store sprite definitions in the RAM under ROM if you use a screen in video banks 2 or 3, in which case you don't have to worry about protecting the sprite patterns from BASIC.

Designing Sprites

Sprite Manager's sprite editor is activated with the DESIGN command. The command has two different forms, depending on whether you wish to design a standard or multicolor sprite. For a standard sprite, use the form:

DESIGN *block number, color*

To design a multicolor sprite, two additional parameters are required:

DESIGN *block number, color, multicolor1, multicolor2*

In either case, the *block number* (0–255) selects which of the 256 available 64-byte sprite definition blocks in the current video bank will be used for the sprite pattern being designed. Be careful that the block you select doesn't use memory that is occupied by your BASIC program or other important information. For example, if you have a program in memory when you activate the editor, you can destroy the program if you select sprite blocks that use the same memory.

Note that the DESIGN command doesn't allow you to specify a video bank. The bank in which the specified sprite block will be stored depends on the bank selected at the time the DESIGN command is issued. Normally, the 64 is configured for bank 0. This can be changed with the Sprite Manager SCREEN statement (see below).

The *color* parameter specifies the foreground color for a standard sprite, or the independent foreground color for a multicolor sprite. The *color* value must be a standard Commodore color number (0–15). These color selections apply only while the sprite is being designed, and have no effect on the colors in which the sprite can later be displayed. The two *multicolor* parameters for multicolor sprites specify the two common foreground colors. These parameter values must also be in the range 0–15. Since the sprite editor provides a white cursor on a black background, it's best to avoid using either white or black (color numbers 0 and 1) as one of the design color selections. Since the two common colors will be the same for all multicolor sprites, you should use the same *multicolor1* and *multicolor2* parameter values for all multicolor sprites you intend to display simultaneously.

When you activate the editor, the design area on the left side of the screen will show whatever pattern is currently in the specified definition block. An asterisk (*) shows which pixel within the pattern is currently being drawn. If no sprite has previously been designed in that block, a random pattern may appear. Press SHIFT-CLR/HOME to clear the design area. Use f3 to paint in foreground color (for standard sprites) or in the independent foreground color (for multicolor sprites). For multicolor sprites, use f5 to paint in the first common foreground color (the *multicolor1* color) and f7 to paint in the second common foreground color (the *multicolor2* color). Use the space bar or f1 to erase with the background color. The cursor keys can be used to move the asterisk around the design area without drawing or erasing. CLR/HOME moves the asterisk to the home position in the upper left corner of the design area. Use INST/DEL to erase the pixel to the left of the asterisk. And remember that SHIFT-CLR/HOME can be used to erase the entire design if you wish to start over.

While you are creating a pattern, four sprites are displayed to the right of the design area. These show the pattern in its normal size, expanded horizontally, expanded vertically, and expanded both horizontally and vertically.

To exit from the sprite editor and return to BASIC, press RUN/STOP (*not* RUN/STOP-RESTORE). Your sprite definition will be in memory at the specified block, but the pattern you designed won't appear on the screen until you use an ENABLE statement to turn on a sprite which uses that block.

Sprite Manager Statements

The new BASIC statements added by Sprite Manager behave just like the existing BASIC statements, with one exception: When one of the new statements is used after THEN in an IF-THEN statement, you must precede the statement with a colon (:) so that it will be recognized by the BASIC interpreter—for example, IF XP(0)>300 THEN:OFF. If you supply a value outside the acceptable range as a parameter for any of these statements, you'll get an ILLEGAL QUANTITY ERROR message. If you supply too many or too few parameters for any statement, you'll get a SYNTAX ERROR message.

Here's a list of the new statements and an explanation of each one:

ALLOFF

Turns off all eight sprites.

ANIM *sprite number, jiffies per frame, starting block, ending block*

Animates the sprite specified by *sprite number* (0–7). The animation is achieved by repeatedly flipping the sprite through a series of pattern definitions. Each of the eight sprites can be animated separately, and different sprites can use the same definition blocks. The *jiffies per frame* parameter (0–255) determines the speed of the animation. This value specifies how long, in jiffies, each pattern in the series is displayed. (A jiffy is 1/60 second.) For example, a value of 15 indicates that the pattern will change every 15/60, or 1/4, second.

The *starting block* and *ending block* parameters determine which blocks will be used in the animation sequence. Either parameter will accept values in the range 0–255, but your ending-block value should be greater than that of the starting block. Also, you should avoid specifying 255 as the ending block. (If 255 is specified, the sequence will not stop at block 255; instead, it will loop back to block 0 and cycle through all 256 blocks.) All blocks in the specified range will be used. The sequence is repeating; when the ending block is reached, the animation begins again at the starting block. ANIM *sprite number* (without any other parameters) halts the animation of the specified sprite.

You should take care that all sprite patterns in the specified range are of the same type, either all standard or all multicolor. Standard sprites look strange displayed in multicolor mode, and multicolor sprites are usually unrecognizable in standard mode. The type selected for the sprite before the animation sequence begins determines the type used in the animation sequence.

A good way to create animation is to design one sprite pattern, copy it to the other blocks in the series using the COPY statement (see below), and then make small modifications to the other blocks with DESIGN. The sprite editor has a special feature to help you see the results of animation immediately. The four sprite shapes displayed on the right side of the sprite editor screen are sprites 0–3 (sprite 0 is the normal-size sprite, 1 is the horizontally expanded one, 2 is the vertically expanded one, and 3 is the one expanded both horizontally and vertically). Use ANIM in immediate mode to start an animation sequence for any or all of sprites 0–3; then use the DESIGN command to edit a block that is part of the animation sequence. The sprite shapes on the sprite editor screen will be animated. Thus, you can see the effects of your editing changes on the animation.

CHANGE *sprite number, block number*

Changes the block used to provide a sprite's pattern definition. CHANGE has a visible effect only if the sprite has previously been enabled. The *sprite number* value selects the sprite (0–7) and the *block number* (0–255) selects which area of memory will hold the sprite's pattern definition. For example, CHANGE 3,14 causes sprite 3 to display the pattern stored in block 14. Note that CHANGE may change a sprite from standard to multicolor, or vice versa, if the pattern in the new block was designed in a different mode.

CHARS *bank, position*

Copies the uppercase/graphics character set from ROM to RAM. The character set consists of 256 eight-byte character pattern definitions, and must start on an even 2K address boundary. Thus, there are eight different slots for character sets in the 16K of address space available in each VIC chip video bank. The CHARS statement lets you select one of these slots by using one of the *position* values shown below:

Position	Offset		Sprite blocks
0	0–2047	$0000–$07FF	0–31
2	2048–4095	$0800–$0FFF	32–63
4	4096–6143	$1000–$17FF	64–95
6	6144–8191	$1800–$1FFF	96–127
8	8192–10239	$2000–$27FF	128–159
10	10240–12287	$2800–$2FFF	160–191
12	12288–14335	$3000–$37FF	192–223
14	14336–16383	$3800–$3FFF	224–255

The offset values shown are the number of bytes from the start of the video bank to the start and end of the character set data. For example, the character set at position 6 in bank 2 begins at address 32768 + 6144, or 38912.

Once you have a copy of the character set in RAM, you can alter the character pattern definitions to create custom characters. You should note, however, that copying a character set to RAM does not automatically cause the VIC chip to use the RAM-based characters. You can select position 4—the position of the uppercase/graphics character set in banks 0 and 2—by printing CHR$(142), or position 6—the position of the lowercase/uppercase character set in banks 0 and 2—by printing CHR$(14). You can also switch between these two character set positions with the SHIFT-Commodore key combination. Other character set positions must be selected with a statement like the following:

POKE 53272, (PEEK(53272) AND 240) OR ***position***

where *position* is one of the values shown above. Note that you can't used RAM-based character sets in positions 4 or 6 of banks 0 or 2. By design, the VIC chip always sees images of the character ROM in these slots.

COLOR *sprite number, color*

Changes the foreground color of a standard sprite, or the independent foreground color of a multicolor sprite. (The other two foreground colors for multicolor sprites are common to all sprites, and are set according to the most recently selected multicolor sprite pattern.)

COPY *source bank, source block, destination bank, destination block*

Copies a sprite definition to another block. The pattern in the source block is unaffected.

This example:

COPY 0,13,0,14

copies the sprite pattern in block 13 to block 14, both blocks in video bank 0.

DUMP *bank, block*

Prints DATA statements representing the sprite pattern in the block you've designed. For example, type DUMP 0,13 to print the pattern data for block 13. Type appropriate line numbers in front of each line, press RETURN, and they'll become part of your program. (Of course, you'll also have to add a statement to POKE the data into memory.) Note that the last line of DATA for each sprite block contains a flag value that Sprite Manager uses to distinguish standard sprite definitions from multicolor ones. If the final DATA item is 0, any sprite enabled using this definition will be standard type. Any nonzero value indicates a multicolor sprite definition. The value then represents the *multicolor1* and *multicolor2* colors. (The number is the result of *multicolor1* * 16 + *multicolor2*.)

ENABLE *sprite number, block, color, x position, y position, x speed, y speed, x size, y size*

Turns on the sprite specified by *sprite number* (0–7). The first time you turn on any sprite, you should specify at least the number, block, color, and position coordinates. Afterwards, you need specify only the number—for example, ENABLE 3—to turn that same sprite on again. The other parameters are optional. The *x position* and *y position* values and the *x size* and *y size* values must be entered in pairs if they are entered at all.

The type of sprite depends on the 64th byte of the definition block. If this location contains 0, the sprite will be standard type. If the byte contains a nonzero value, then the sprite will be multicolor, and the byte's value will determine the two common foreground colors (*multicolor1* and *multicolor2*). This is a special feature of Sprite Manager; the final byte of each definition block is normally unused. When sprites are designed using Sprite Manager's editor (using the DESIGN command), this byte will be set according to the two *multicolor* colors selected when the sprite was designed. However, if you use some other sprite design utility, you may have to explicitly change the final byte of each block to the appropriate value. Note that the two foreground colors common to all multicolor sprites are redefined each time a new multicolor sprite is enabled, so these two colors will always depend on the colors used for the most recently enabled multicolor sprite.

Turning on a sprite doesn't necessarily make it visible on the screen. The sprite will still be invisible if its selected pattern is blank, if its foreground color is the same as the screen background color, or if it is positioned off the active portion of the screen. The horizontal position parameter, *x position*, can take values in the range 0–511, but the entire sprite pattern area is visible only for positions 24–343. Likewise, the vertical position parameter, *y position*, can take values in the range 0–255, but the entire pattern area is visible only for positions 50–249. The coordinates specify the position of the upper left corner of the sprite pattern area, so part of the design may be still visible when the sprite is outside these ranges.

The value of *x speed* (from −128 to 127) specifies the rate of horizontal motion and the value of *y speed* (−128–127) specifies the rate of vertical motion. Negative numbers move the sprite up or left; positive values move the sprite down or right. The larger the number, the faster the sprite moves. For a stationary sprite, specify 0 for both of these parameters. Moving sprites will wrap around whenever their coordinates exceed the maximum or minimum values in any direction. For example, a sprite which moves downward off the bottom of the screen will reappear at the top. Remember that there is a large area in the right portion of the coordinates in which the sprite will be invisible, so a sprite which moves off the left or right edge of the screen will not reappear immediately at the other edge.

The *x size* and *y size* parameters control the sprite expansion feature. An *x size* value of 0 selects the normal horizontal size, while a value of 1 doubles the horizontal size. A *y size* value of 0 selects the normal vertical size, while a value of 1 doubles the vertical size.

Once a sprite has been enabled, its block, color, position, motion, and expansion characteristics can be changed using the CHANGE, COLOR, REL, MOVE, and SIZE statements, respectively.

MOVE *sprite number, x speed, y speed*

Changes the motion characteristics of the sprite specified by *sprite number* (0–7). MOVE has an obvious effect only if the sprite was previously enabled. The *x speed* and *y speed* parameters take the same values as in the ENABLE statement (−128–127). A moving sprite can be stopped by specifying *x speed* and *y speed* values of 0.

OFF *sprite number*

Turns off the sprite specified by *sprite number* (0–7). If the ENABLE statement is later used to turn the sprite back on, it will reappear, stationary, at the position it occupied when turned off.

PRIORITY *sprite number, priority*

Determines whether the sprite specified by *sprite number* (0–7) will appear to move over or under text and other screen foreground objects. A *priority* value of 0 causes the sprite to appear in front of screen foreground objects such as text, while a *priority* value of 1 causes the sprite to appear behind screen foreground objects.

REL *sprite number, x position, y position*

Relocates the sprite specified by *sprite number* (0–7). The sprite must be enabled for this to have any visible effect. The *x position* and *y position* parameters take the same values as in the ENABLE statement.

SCREEN *bank, position*

Moves screen memory to the specified area of RAM. Screen memory occupies 1000 bytes, and must begin on an even 1K address boundary. Thus, there are 16 possible locations for screen memory in each 16K video bank (the *bank* parameter can take values 0–3). Screen memory can even be located in the RAM under ROM. The following table shows the location of screen memory for various *position* values:

Position	Offset		Sprite blocks
0	0–1023	$0000–$03FF	0–15
1	1024–2047	$0400–$07FF	16–31
2	2048–3071	$0800–$0BFF	32–47
3	3072–4095	$0C00–$0FFF	48–63
4	4096–5119	$1000–$13FF	64–79
5	5120–6143	$1400–$17FF	80–95
6	6144–7167	$1800–$1BFF	96–111
7	7168–8191	$1C00–$1FFF	112–127
8	8192–9215	$2000–$23FF	128–143
9	9216–10239	$2400–$27FF	144–159
10	10240–11263	$2800–$2BFF	160–175
11	11264–12287	$2C00–$2FFF	176–191
12	12288–13311	$3000–$33FF	192–207
13	13312–14335	$3400–$37FF	208–223
14	14336–15359	$3800–$3BFF	224–239
15	15360–16383	$3C00–$3FFF	240–255

The offset values shown are the number of bytes from the start of the video bank to the start and end of screen memory. For example, screen memory at position 1 in bank 2 begins at address 32768 + 1024, or 33792.

Remember that the bank in which screen memory is located also determines the bank in which sprite patterns and character memory are located. For screens in video banks 1 or 3 where no image of character ROM is seen, you must have a RAM-based character set in place to display any characters. And any sprite patterns you wish to use must be in the same bank as the screen. You should be careful that your choice of screen positions does not conflict with character memory. The VIC chip sees an image of character ROM in screen positions 4–7 of banks 0 and 2, so those screen position selections should not be used. Also, remember that the sprite blocks for the selected screen position cannot be used for pattern definitions. The default position for screen memory is in slot 1 of video bank 0 (addresses 1024–2023). The following example:

```
SCREEN 1,8:CHARS 1,4
```

moves the screen to locations 24576–25575 and copies the character ROM to locations 20480–22527. (Without a character set in video bank 1, it would be impossible to display characters on a screen in that bank.) To return to normal screen memory (locations 1024–2023 in bank 0), clear the screen and enter SCREEN 0,1.

SIZE *sprite number, x size, y size*

Controls the horizontal or vertical expansion of the sprite specified by *sprite number* (0–7). The *x size* and *y size* parameters take the same values as in the ENABLE statement (0 or 1). The sprite must be enabled for SIZE to have any immediately visible effect.

SOUND *number, tone, jiffies, repeat, attack, decay, sustain, release, waveform, pulsewidth*

Defines a sound which can be made to repeat while other BASIC statements are executing. Up to 16 different sounds can be defined, each with its own *number* parameter (0–15). However, only one sound can be active at a time. Each new SOUND statement supercedes the previous one. The first time you define a sound, you should specify values for all the parameters. After the first time, all values besides the sound number are optional. For example, after you have defined all the parameters for sound 12, you can generate the same tone again using just

```
SOUND 12
```

The *tone* parameter (0–65535) determines the frequency of the sound. The relationship between frequency (in hertz) and *tone* value is

frequency = tone value * 0.06096

Once you have defined a sound, you can generate another tone with the same waveform characteristics by using the sound number with a new *tone* value, as in

```
SOUND 12,4292
```

The *jiffies* parameter specifies the duration of the sound (0–255). For example, a value of 60 will result in a sound one second long. The *repeat* parameter controls the repeat rate of the sound. If you want a single, nonrepeating tone, use a *repeat* value of 0. Nonzero values (1–255 are allowed) specify how frequently (in jiffies) the sound will be repeated. In this case, the *repeat* value should be greater than or equal to the *jiffies* value. Repeating sounds will continue even while other BASIC statements are being executed. You can stop a repeating sound using a SOUND statement with a *repeat* value of 0.

The *attack, decay, sustain,* and *release* parameters define the envelope of the sound wave. All take values in the range 0–15; the larger the value, the more pronounced the effect. If you specify an *attack* value you must also specify a *decay* value, and vice versa. Likewise, if you specify a *sustain* value you must also specify a *release* value, and vice versa.

The *waveform* parameter specifies the shape of the sound wave. Use the value 0 to select a triangle waveform, 1 for sawtooth, 2 for pulse, or 3 for noise. The *pulsewidth* parameter is meaningful only in conjunction with the pulse waveform (*waveform* = 2). In that case, it specifies the duty cycle of the pulse (0–15).

Here's an example:

```
100 SOUND 4,0,3,5,1,0,15,5,1
110 FOR X=1 TO 8:READ A:SOUND
    4,A:FOR DE=1 TO 400:NEXT DE:
    NEXT X
120 DATA 4291,4817,5407,5728,6430,7217,
    8101,8583
130 SOUND 4,0,0,0:REM SOUND OFF
```

Sprite Manager's Functions

In addition to the statements above, Sprite Manager provides a valuable collection of functions. If you're unfamiliar with the difference between statements and functions, remember that statements cause actions while functions return values. Functions appear on the right side of assignments, as in

```
X1 = XP(4)
```

Functions can also be used in IF-THEN statements, as in

```
IF XP(4)>343 THEN: MOVE 4,−20,0
```

The following list describes all the Sprite Manager functions. Since most function names are two characters long, you must be careful in programs which use Sprite Manager not to define numeric arrays which use the same names as are used for these functions.

FG(*n*)

Returns the value −1 if sprite *n* (0–7) has collided with text characters or other screen foreground objects, or 0 if it has not. Each sprite has a separate register, which remains set following a collision until you use this function. Here's an example:

```
IF FG(7) THEN:SOUND 0:ANIM7,8,192,
194:OFF 7
```

JOY(*n*)

Returns the value 0 if the joystick connected to the port specified by *n* (1–2) is not currently being pushed in any direction. When the stick is pushed up, down, left, or right, the function returns values of 1, 2, 4, or 8, respectively. The values are cumulative; for example, if the stick is being pushed up and right simultaneously, the value returned will be 9. If the fire button is pressed, 16 will be added to the direction value.

SP(*n*)

Returns the value −1 if sprite *n* (0–7) has collided with any other sprite, or 0 if it has not. Note that the value indicates only whether a particular sprite has hit another sprite; it does not identify which other sprite or sprites were involved in the collision. Each sprite has a separate register, which remains set following a collision until you use this function.

XP(*n*)

Returns a value in the range 0–511 representing the current horizontal position of sprite *n* (0–7).

Here's an example:

```
IF XP(0)>300 THEN: OFF 0
```

YP(*n*)

Returns a value in the range 0–255 representing the current vertical position of sprite *n* (0–7).

Remember that programs using the special statements and functions of Sprite Manager will not run unless Sprite Manager has first been loaded and activated.

See program listing on page 106.

RAM Plus

Buck Childress

Add an extra 4K of RAM to BASIC with this utility, and your programs can include more sprite data, music data, text, or larger arrays. For the Commodore 64.

If you've ever run out of memory when you're writing a program, you know it's a frustrating experience. Arrays, sprite definitions, and large amounts of text can fill up RAM all too quickly.

"RAM Plus," the short machine language utility accompanying this article, offers a solution. Using RAM Plus adds an extra 4096 bytes, and installing the program is easy. Since the program is written entirely in machine language, it must be entered using the "MLX" machine language entry program found elsewhere in this issue. When you run MLX, you'll be asked for a starting address and an ending address for the data you'll be entering. The values for RAM Plus are as follows:

Starting address: 9470
Ending address: 972F

When you've finished typing in the program, be sure to save a copy to tape or disk before leaving MLX. To use RAM Plus, type LOAD "*filename*",8,1 (tape users should substitute ,1,1 for the ,8,1) where *filename* is the name you used when saving the program. After the program has loaded, type NEW and press RETURN to reset important memory pointers, then enter SYS 38000 to activate RAM Plus. If the program has been installed correctly, you'll see the BASIC startup message. However, notice that you now have 43007 bytes free instead of the usual 38911.

Remember that programs written to take advantage of the extra RAM won't run unless RAM Plus has been installed.

Press RESTORE or RUN/STOP–RESTORE to disable RAM Plus. The program will ask whether you really want to exit RAM Plus. If you do, press Y. Once RAM Plus has been disabled, it cannot be reenabled without resetting the computer and reloading the program. The program uses locations 679–767 and 49152–53247, so it can't be used with other utilities that occupy these areas.

See program listing on page 104.

CP/M PIP On The Commodore 128

Richard Terry

PIP, one of the most commonly used CP/M commands, is best known for its use as a file copier. But there's a lot more to this command than meets the eye.

In this article we'll take a close look at an extremely versatile CP/M command: The Peripheral Interchange Program, also known as PIP.

Let's start with a hands-on demonstration. First, boot CP/M by placing a CP/M disk in the drive and turning on your computer. When the system has finished loading, the prompt *A>* appears on the screen.

There are two types of commands in CP/M—built-in and transient. A built-in command is one that doesn't need a program disk in the drive to execute. There are six of these: DIR, DIRSYS, ERASE, RENAME, TYPE, and USER. A transient command is one which resides on disk. Since PIP is a transient command, you'll need the system disk in the drive when you call it.

PIP can be used in two ways. If you type the word PIP, the PIP.COM program runs (you'll see its prompt, the asterisk). To cancel PIP and return to the *A>* prompt, press RETURN alone at the asterisk prompt. If you type PIP with parameters, PIP copies the specified file or files and then returns control to the system. If PIP is on the disk in your drive, you can type:

PIP A:*oldname.filetype*=A:
newname.filetype

If you're going to be using PIP for a series of file moves, you can save time by loading PIP without parameters. Here's an example of this method:

PIP
A:*oldname.filetype*=A:*newname.filetype

These two commands—the first treating PIP as a command; the second, as a program—make a copy of a file on your current disk.

Since it's always a good idea to have backup copies of your disks, our first exercise is to make a copy of our CP/M 3.0 system disk. Use the FORMAT command to format a new disk and follow the instructions to set up the boot tracks on the newly formatted disk. When the *A>* prompt appears, remove the formatted disk, place the CP/M system disk in the drive, and type PIP. If you have two drives, place the formatted disk in drive B and type:

B:=A:CPM+.SYS
B:=A:CCP.COM

If you have one drive, type:

E:=A:CPM+.SYS
E:=A:CCP.COM

Then put your backup disk in the drive and type:

A:=E:CPM+.SYS
A:=E:CCP.COM

This makes a new boot disk with the CP/M operating system on it. To copy all the files from the CP/M master disk, use the following command:

PIP B:=A:*.* (with two drives)

or

PIP E:=A*.* (with one drive)

If you have one drive, swap disks now, and type:

PIP A:E*.*

Commands for one drive differ from commands for two drives only in the designation of the drives. PIP B means *to drive B from drive A*. PIP E means *to drive E from drive A.*

Drive E—a simulated disk drive in memory—is referred to as a virtual drive. From now on we'll look at the two drive commands.

As PIP copies a file, it displays its filename on the screen. When it has finished, the *A*> prompt reappears. If you have a 1571 drive, turn over the original disk and copy the utility files with **B:=A:*.***. Now you have all of the system files on one disk. The asterisk (*) is known as a wild card and can be used to select more than one file. If you wanted to copy all of your text files to one disk, you could use **B=A:*.TXT**. To copy all files beginning with the letter B, use **B=A:B*.***. The question mark (?) is also a wild card. While * can stand for a group of letters, a ? stands for a single letter. To cancel PIP when you've finished, press CTRL-C or RETURN.

Among the many options available within PIP is the Verify option. After copying the file, the system reads and compares it to the original file. Its syntax is **B:=A:*.*[V]**. Note that these are brackets, not parentheses. On the 128 keyboard, the brackets are found in the SHIFTed positions of the colon (:) and semicolon (;) keys. Also use [R] if the disk contains system files that you want to copy. The command **B:=A:*.*[VR]** copies all files from the disk in drive A to the disk in drive B and verifies each copy. With PIP loaded into memory, you can change disks before entering the copy commands.

More Than Copying

PIP has many other uses besides copying files. You can concatenate files (join them together)—for example:

BOOK.TXT=CHP1.TXT[V], CHP2.TXT[V],CHP3.TXT[V]

This copies the text files CHP1, CHP2, CHP3 into one file named BOOK.TXT. To create the book file on another disk, enter:

B:BOOK.TXT=A:CHP1.TXT[V], A:CHP2.TXT[V],A:CHP3.TXT[V]

This does the same thing as the previous command except that it puts the new file on the disk in drive B.

It may take a long time to copy all the files on a disk, so PIP has an option that allows you to make backup copies of only the files which have been altered since the last copy. When you alter a file, CP/M sets a flag in the file, known as the *archive flag*. Use **B:=A:*.TXT[AV]** (*A* stands for archive; *V* stands for verify). This creates backups of all the text files that have been changed on the disk. After each file is copied, it is verified and the archive flag is reset. You can see the current status of your files by typing **DIR[FULL]**. You'll see *arcv* in the attribute column if a file needs to be backed up. The echo parameter lets you see a file as it is being copied. The echo command is entered like this:

B:BOOK.TXT.=A:BOOK1.TXT[E].

The file BOOK1.TXT will be displayed on the screen as it is being copied to the disk in drive B as BOOK.TXT.

PIP can also be used to display and print files. To display a file on your screen, type **PIP CON:=A: BOOK.TXT**. CON is the device name for the console keyboard. This works like the TYPE command, but PIP is more versatile. The keyword LST can also be used to print a file. Enter **LST:=A: BOOK.TXT**. This will also print a file just as it is. Enter **PRN:=A: BOOK.TXT**. PRN is a special keyword that configures the printer to print sequential line numbers, setting the tab to eight columns, and creating a form feed every 60 lines. Here's a list of the options available with LST:

N **Adds line numbers to listing.**
U **Prints the listing entirely in uppercase.**
L **Prints the listing entirely in lowercase.**
F **Removes any form feeds.**
P*n* **Form feed is executed every *n* lines.**
T*n* **Tabs are set for every *n* columns.**

You can use these options in combination with others. For example, you may want to print a file in all uppercase letters with a form feed every 55 lines and filter out any form feeds embedded in the file. The command would look like this: **LST:=A:BOOK.TXT[UP55F]**. A file printed with **LST:=A: BOOK.TXT[LT5]** would print in lowercase with tabs set for every five columns.

Following is a list of possible PIP commands with descriptions:

PIP Commands

PIP B:=A:BOOK.TXT
Copy a file to the disk in B from the disk in drive A.

PIP B:=A:*.*
Copy all files on the disk in drive A to the disk in drive B.

PIP B:=A:*.*[V]
Copy all files and verify them.

PIP B:=A:*.TXT
Copy all text files from the disk in drive A to the one in drive B.

PIP B:=A:BOOK.*
Copy all files named BOOK from the disk in drive A to the one in drive B.

PIP B:=A:*.*[VR]
Copy all files and system files from drive A to drive B, and verify the files as they are copied.

PIP B:BIGFILE.TXT=CHPT1.TXT[V],CHP2.TXT[V],CHPT3.TXT[V]
Merge several files into one large file.

PIP B:=A:*.TXT[AV]
Copy (back up) altered text files.

PIP B:BOOK.TXT=BOOK1.TXT[E]
Copy the text file named BOOK1, giving the new file the name BOOK and displaying the file on the screen as it is copied.

PIP CON:=A:BOOK.TXT
Display the text file named BOOK on the screen.

PIP LST:=A:BOOK.TXT
Print the text file named BOOK on the printer.

PIP PRN:=A:BOOK.TXT
Print the specified file with default parameters.

Options of the LST command:

PIP LST:=A:BOOK.TXT[NUFP50T10]
Print the specified file with line numbers (N) in uppercase (U); filter form feeds (F); set page length to 50 (P50); set tabs to 10 (T10).

PIP LST:=A:BOOK.TXT[NLFP50T10]
Print the file as above except in lowercase.

Custom Keys

Amy Galtman

This pair of utility programs lets you redefine the Commodore 64's keyboard. You can easily change a single key or the whole keyboard. And when you've found the perfect arrangement, you can save it to disk or tape for later use.

If you've ever wanted to change your 64's keyboard around, you'll enjoy using the two Custom Keys programs. You can try a Dvorak or alphabetic arrangement, or invent your own. There are other possibilities, too. You could put several commonly used keys on the bottom row to make it easy for children to access the keyboard.

Custom Keys consists of two programs. The first, "Custom Keys Creator," lets you change the keyboard and save your definitions to tape or disk. The second, "Custom Keys Loader," lets you load any of the keyboard definitions that you've saved.

Using The Programs

First, type in Program 1, Custom Keys Creator. Since it's written in machine language, you'll need to enter it with the "MLX" machine language entry program found elsewhere in this issue. When MLX asks for starting and ending addresses, reply with the following values:

Starting address: C000
Ending address: C1EF

For a version that saves keyboard definitions to tape instead of disk, substitute the following line when entering the data:

```
C1C0:6D C0 A9 01 A2 01 A0 01 CB
```

When you've finished entering the program, save a copy to tape or disk before you exit from MLX.

The second program, Custom Keys Loader, is also written in machine language. Run MLX again, this time using these addresses:

Starting Address: CF05
Ending Address: CFE4

For a version that loads keyboard definitions from tape instead of disk, substitute the following line when entering the data:

```
CF5D:CE 36 CF A9 01 A2 01 A0 BB
```

When you've finished entering this program, save it with a filename different from the one you used for the first program.

Adding Dvorak

The Commodore 64's keyboard layout is derived from the standard typewriter arrangement, known as *qwerty*—from the leftmost six keys in the upper row of letters. However, alternative layouts are sometimes used. One of the most common of these is the Dvorak keyboard, named for its developer, August Dvorak. Advocates of this arrangement claim that it allows faster and easier typing of the English language. Here's a diagram of the Dvorak layout:

/ , . P Y F G C R L ; =
A O E U I D H T N S -
' Q J K X B M W V Z

As an example of using Custom Keys, redefine your keyboard for the Dvorak arrangement. First, load and activate your copy of Custom Keys Creator. Use a statement of the form LOAD"*filename*",8,1, (where *filename* is the name you used when you saved the data from Program 1). Tape users should substitute ,1,1 for the ,8,1. After the program has been loaded from disk or tape, type NEW and press RETURN to reset important memory pointers; then enter SYS 49152 to activate the Creator program. You should see the following message on the screen:

THE KEY MARKED -?-

Here, the program is asking which key you would like to change. Since you'll be redefining all of the keys, start with the Q key. Press Q. Now you'll see this message:

THE KEY MARKED -Q- SHOULD REPRESENT THE CHARACTER: -?-

Since the / key in the Dvorak arrangement occupies the same position as the Q key in the qwerty arrangement, press /. Continue with the definitions, changing the W key to a comma, the E key to a period, and so on.

When you've changed the definitions of all the keys, press CTRL-Q to quit. You'll be asked if you want to save your new keyboard set. Answer *Y* for *yes*. The program then asks for a filename. Type DVORAK. Your key definitions will be saved on disk or tape.

You should be aware that your new keyboard definitions become active as soon as you select the Quit option. Thus, if you redefine the Y key and fail to create a new Y, you'll be unable to answer *Y* to the save prompt, and thus will be unable to save your keyboard definitions.

Of course, when you turn your computer off or press RUN/STOP–RESTORE, your definitions are lost. To regain them, use Program 2, Custom Keys Loader. Use a command of the form LOAD"*filename*",8,1, (where *filename* is the name you used when you saved the data from Program 2). Tape users should substitute ,1,1 for the ,8,1. When the load is complete, type NEW and press RETURN to reset important memory pointers; then type SYS 53047 to activate the Loader program. When asked for a filename, type DVORAK. Your definitions load in and are automatically put into effect.

Key Combinations And Function Keys

Custom Keys Creator allows you to redefine all the keys, including SHIFT combinations, Commodore-key combinations, and function keys. Be careful to define all the keys you need: For example, don't define the L key to be an S without defining another key to be an L—unless you're sure you're not going to need an L.

The Custom Keys programs move both BASIC and the operating system into the RAM below the ROMs, so you can't use your keyboard definitions with other programs which use this RAM.

See program listings on page 104.

ROM Enhancer

Joseph T. Heaverin

You'll be amazed at how much BASIC 2.0 is improved with this short machine language program. Although it's especially useful for disk users, it also has many enhancements that tape users will enjoy. For the Commodore 64.

Did you ever wish that BASIC was just a little different? For instance, wouldn't it be handy if you could just type LOAD"PROGRAM" instead of LOAD"PROGRAM",8? And wouldn't it be easier to read if FRE(0) always returned positive numbers? I made a long wish list and used it to create a modified BASIC: "ROM Enhancer." Here are the changes made to BASIC:

- LOAD, SAVE, and VERIFY all default to disk instead of tape. Just type one of these commands followed by the filename in quotation marks. (Tape users must use LOAD"*filename*",1, SAVE"*filename*",1, and VERIFY"*filename*",1 instead of LOAD"*filename*", SAVE"*filename*", and VERIFY"*filename*", which are now considered to be commands to the disk drive.)
- INPUT no longer inserts a question mark and a space on the screen after the prompt.
- The error messages EXTRA IGNORED and REDO FROM START have been removed.
- GOTO and GOSUB may be followed by a variable or expression. For example, 10 GOTO A*10+1000 is now a legal BASIC program line. This is especially useful for named subroutines, as the following example shows:

```
10 MOVE=1000:SHOOT=2000:SCORE=
   3000
20 GOSUB MOVE
30 GOSUB SHOOT
40 GOSUB SCORE
50 GOTO 20
```

(Of course, this program segment assumes the existence of subroutines at lines 1000, 2000, and 3000.)

- RESTORE may be followed by a line number, variable, or expression. This makes it easy to READ data beginning at any program line.
- THEN is no longer needed after an IF when you use PRINT or GOSUB. (You can now type IF A<4 PRINT A.)
- When you try to find the ASCII value of an empty string (with BASIC's ASC function), you get 0 instead of an ILLEGAL QUANTITY error message.
- FRE always returns a positive number, which is the number of available bytes.
- RUN can be followed by a filename to load and run a program—for example: RUN"GAME".
- When numbers are printed, they are separated by spaces instead of cursor-rights. (This is important when the screen is already cluttered with characters.)
- RUN/STOP–RESTORE resets both pointers to the screen. This means that if you change the memory location of your screen and then press RUN/STOP–RESTORE, you'll be able to see what you're typing.
- PRINT CHR$(15) or CTRL-O switches to uppercase mode even when the SHIFT–Commodore key combination is disabled.

I changed BASIC by copying it from ROM to RAM and making certain code replacements or *patches*. Of course, no software makes a permanent change, but once loaded, ROM Enhancer is in place until the power is turned off. RUN/STOP–RESTORE has no effect on ROM Enhancer.

Since ROM Enhancer is written entirely in machine language, you'll need to use "MLX," the machine language entry program found elsewhere in this issue, to type it in. Be sure to read the instructions for using MLX before you begin entering the data for ROM Enhancer. When you run MLX, you'll be asked for the starting and ending addresses for the data you'll be entering. Answer with these values:

Starting address: C000
Ending address: C1AF

When you've finished typing in all the data, be sure to save a copy before leaving MLX.

To use ROM Enhancer, type LOAD"*filename*",8,1. (For *filename*, substitute the name you used when you saved the program. Tape users should substitute ,1,1 for the ,8,1.) Activate ROM Enhancer by typing SYS 49152. When the READY prompt appears, BASIC has been modified.

Don't activate ROM Enhancer more than once. If you're not sure whether it's active, type ?ASC(""). If the computer responds with a 0 instead of an error message, ROM Enhancer is resident. Activating the program twice could cause the computer to lock up.

Also, be aware that any programs you write while ROM Enhancer is activated won't work properly in standard BASIC 2.0 if the programs take advantage of the special behavior of those statements modified by ROM Enhancer. So remember to always load and activate ROM Enhancer before loading these programs.

See program listing on page 110.

128 Partitioner

Shawn Smith

Turn your 128 into four independent computers with this short machine language program. You can load as many as four BASIC programs into memory at once. Also included are merging and autorun features.

Ever since the days of the first PET and CBM computers, Commodore owners have been segmenting the memory of their computers by manipulating BASIC's pointers. Now, you can do the same with your 128 with "128 Partitioner."

There are several applications for this program. After splitting memory into four pieces, you could load a different program into each of the partitions and easily switch between them. Partitioner also makes it simple to transfer lines from one program to another, and offers an automatic run feature.

Partitioner is written in machine language, but you don't need to know machine language to use it. The program is in the form of a BASIC loader. Since there are many DATA statements which require accurate typing, use "The Automatic Proofreader" program found elsewhere in this issue. When you've finished typing in the program, be sure to save a copy to disk or tape before running it. Now load the program with a statement of the form LOAD"PARTITIONER",8 (use ,1 if you're using tape instead of disk). Substitute the name you used when you saved the program.

To use Partitioner, type RUN. Once the program has installed the machine language part of itself, the BASIC program is erased. Therefore, be sure that you've saved a copy of the program before you run it. When the cursor appears on the screen, you're in partition 1. Type PRINT FRE(0) and you'll see that you have about 16K of memory free for BASIC programming. The first three partitions have 16K free and the fourth has 8K. To go to any partition, type SYS 6555,*x*, where *x* represents the number of the partition that you wish to enter. Remember, partitions are numbered from 1 to 4. If you ever lose track of what partition you're in, type PRINT PEEK(6655) to display the current partition number.

Moving Lines

Let's see how we can use Partitioner to merge lines from one program to another. First, type SYS 6555,1 to enter partition 1, then type in the following short program:

```
10 PRINT N
20 N=N+1
30 GOTO 10
```

Run this program to see what it does—you'll have to press the RUN/STOP key to halt it. Now, enter SYS 6555,2 to switch to partition 2; then type in this program:

```
15 PRINT M
25 M=M-1
35 GOTO 15
```

Run this program. Now we'll merge the lines from partition 2 into the program in partition 1. Make sure you're still in partition 2—use PRINT PEEK(6655) if you're not certain. Type LIST. Now type SYS 6555,1 to go back to partition 1. Use the cursor keys to move up to line 15 on the screen and press RETURN three times to enter the lines into the program. Type LIST to see the merged program.

Automatic Run Feature

Partition 4 has an automatic run feature. When you type SYS 6555,4, the program in partition 4 runs automatically. You can turn this feature off, if you like, or add it to the other partitions. To turn autorun on for any of the other partitions, type POKE 6647+*x*,1 (where *x* is the partition number). To turn autorun off for any partition, type POKE 6647+*x*,0.

Programs that use the GRAPHIC command are likely to cause trouble if they don't deallocate the 10K screen area when they are through. If you use programs with the GRAPHIC command, be sure that the program performs a GRAPHIC CLR command before returning control to BASIC.

See program listing on page 103.

computing for families

Beyond The Desktop: Soap Bubbles, Forests, And Hot-Air Balloons

Fred D'Ignazio
Associate Editor

In May 1986 I was deep in a giant cereal bowl known as the British Columbia Hockey Arena. Sitting high above me on wooden bleachers were over 7000 people, their faces distant and indistinct. In my speech, I said that we computer people already had plenty of good ideas. What we needed desperately were new *metaphors*—vivid images to set fire to our imaginations. I suggested the sandbox as a metaphor for human interaction with computers and other high-tech equipment. Sand is an excellent medium for young children's hands and minds, something that can be shaped, squashed, and reshaped—a medium that is gritty and stimulating to the senses, but which doesn't get in the way of the child's imagination.

Later in the day, Becky Lowenthal from Australia rushed up to me and told me that her own metaphor was soap bubbles and bubble baths. For Becky, soap bubbles evoked images of flight, beauty, geometry, nature, and freedom. They could be shaped and they sprang from a bubble bath—a warm, relaxing treat.

Becky's bubble bath and my sandbox represent human/technological metaphors—higher-order patterns which integrate human/machine capabilities with our wishes and desires and transform them into vivid images which we can relate to emotionally. We are firmly in control of the medium, and the medium stimulates and *celebrates* our senses and our imagination. And, last, both metaphors are dreamlike and extremely nontechnical.

The Forest In Your Mind

Designers of both computer hardware and software have created some powerful mental structures—thinking environments—which we can "model" in our own everyday thinking and problem solving. We can manipulate words inside our heads using our own internal, intuitive word processor or desktop publishing program. We can organize information in spreadsheet or database formats, structure and prioritize according to idea processors. We can solve problems algorithmically and methodically, just as we would program them on a computer.

Computer scientists love to speculate about an imaginary computer known as the Turing Machine (after Alan Turing, the famous computer scientist). The Turing Machine is so powerful it can imitate any other computer. But the human imagination is even more powerful. It can model any Turing Machine.

Word processors and database programs are exciting, but let's face it, they are creatures of the desktop. Our human world extends far beyond the desktop—to the highest, windswept mountains, to the frothiest seas, and into the deepest forests.

We are on the threshold of a new era of multimedia computing which will carry us away from the desktop into the broader human world. Electronic technology is swiftly becoming digital, and compact discs (CD-ROMs, and so on) will soon become less expensive and more versatile. In the near future, when we sit down at our personal computer we will face not only trashcans and file folders, but also mountains, seas, and forests—simulated in digital high-fidelity sound and full-motion animation.

Now I ask you: Is it appropriate to enter a forest through a file folder?

You be the judge. But for my part, I would rather enter this new, multimedia computing world through a more imaginative human/computer interface: by skiing down a Colorado mountain with fresh powder snow sprinkling my nose, or by fishing in a deep glacial lake, guarded by tall, green pine trees under a blue sky.

Or by floating in a hot-air balloon.

Pretend You Are Jules Verne

When I bring my multimedia dog-and-pony show to children, I have them close their eyes and pretend they are Jules Verne, floating in a hot-air balloon, high over the earth.

When they open their eyes and look down at the earth, they see an enlarged poster-size picture of a Motorola 68000 microprocessor. "Pretend this is a city below you," I tell them, "A giant city—a New York—with its neighborhoods, its flower, business, commercial, and artistic districts. There is a hustle and bustle of activity. What can you see?" And the children see data being processed as noisy, colorful parades; they see memory circuits as tall skyscrapers. They can feel the microprocessor's functionality and the system-wide integration, just as you can hear the pile drivers tearing up a New York City street, smell the Chinese vegetables in a nearby open-air market, and feel the rumble of the subway passing beneath your shoes.

We have an unquenchable thirst for metaphor. It is time for us to start designing fresh, new metaphors for our computers. Desktops can carry us only a baby step into the future. The human imagination can handle so much more!

BASIC for beginners

More On IF-THEN

Larry Cotton

Let's get back into the powerful IF-THEN statement. Last month we looked at a programming technique similar to this:

```
10 INPUT "PRINT RESULTS OR QUIT
   (P/Q)";I$
20 IF I$="P" THEN 40
```

This is one way to do line 30:

```
30 IF I$="Q" THEN PRINT "GOOD-
   BYE!": END
```

Here's another:

```
30 PRINT "GOOD-BYE!": END
```

Why can you leave out the second IF-THEN? Because if the user's response is anything but *P* the program goes to line 30 anyway. There's no need to test for *Q*. (Of course, if you want to be sure nothing but *Q* is pressed, the first method is the way to go.)

In this program, the results would be printed beginning with line 40.

There are always many ways of accomplishing a given comparison with the IF-THEN statement. Let's look at an example—multiple choice questions.

```
10 INPUT "DIRECTION";A$
20 IF A$<>"UP" THEN IF A$<>
   "DOWN" THEN IF A$<>"RIGHT"
   THEN IF A$<>"LEFT" THEN 70
30 IF A$="UP" THEN PRINT "GOING
   UP": END
40 IF A$="DOWN" THEN PRINT "GO
   ING DOWN": END
50 IF A$="RIGHT" THEN PRINT "GO
   ING RIGHT": END
60 IF A$ ="LEFT" THEN PRINT "GO
   ING LEFT": END
70 PRINT "TRY AGAIN": GOTO 10
```

We don't really need the multiple IF-THEN tests in line 20. But they don't hurt—they're just redundant. This also works:

```
10 INPUT "DIRECTION";A$
20 IF A$="UP" THEN 70
30 IF A$="DOWN" THEN 80
40 IF A$="RIGHT" THEN 90
50 IF A$="LEFT" THEN 100
60 PRINT "TRY AGAIN": GOTO 10
70 PRINT "GOING UP": END
80 PRINT "GOING DOWN": END
90 PRINT "GOING RIGHT": END
100 PRINT "GOING LEFT": END
```

Or better yet:

```
10 INPUT "DIRECTION";A$
20 IF A$="UP" THEN PRINT "GOING
   UP": END
30 IF A$="DOWN" THEN PRINT "GO
   ING DOWN": END
40 IF A$="RIGHT" THEN PRINT "GO
   ING RIGHT": END
50 IF A$="LEFT" THEN PRINT "GO
   ING LEFT": END
60 PRINT "TRY AGAIN": GOTO 10
```

Note that line 60 is executed only if the four tests in lines 20–50 fail.

Which variation is best? I use four criteria to decide:

- Does it always work?
- Is it efficient?
- Is it easily understandable?
- Is it elegant?

That last criterion can be a problem. One programmer's definition of elegant may not be another's. Usually an elegant program invokes the response: "Hey, clever! Why didn't I think of that?"

Don't worry if your programs aren't yet elegant. After all, we've learned only a few BASIC commands. Stick around—you'll get more proficient with every BASIC program line you write.

Next month we'll be covering GOTO and GOSUB.

BASIC In Review

Before we close this month, let's review what we've covered so far in this column, which began last October. Here, in alphabetical order, is a guide to all the BASIC statements we've covered.

END (February): The BASIC statement which causes a program to finish execution.

FOR-NEXT (January): Used to repeat a group of statements a certain number of times.

GOTO (October and February): Sends control of a program to a particular program line. Many programmers prefer GOSUB (I'll discuss both next month). If not properly used, GOTOs may lead to confusing programs that even the programmer has difficulty figuring out.

IF-THEN (February): The statement which gives BASIC the power to make decisions—IF such and such a condition exists, THEN do something.

INPUT (December): Suspends a BASIC program until the user enters information and presses RETURN. INPUT is followed by a variable name, such as D or D$.

LIST (October): The BASIC command used to display the contents of a BASIC program or a disk directory.

LOAD (November): The BASIC command used to retrieve a program from a disk or cassette tape.

NEW (December): The BASIC command which erases any BASIC program in your computer's memory.

PRINT (October, November, and December): One of the most widely used BASIC commands, this command is capable of moving the cursor, changing colors, and putting information on the screen. PRINT can be followed by text in quotes, variables (numeric and string), math functions, a comma, a colon, or nothing at all.

RUN (October): The BASIC command which begins execution of a BASIC program.

SAVE (November): The BASIC command used to store a program in the computer's memory to a disk or tape.

STEP (January): An optional part of FOR-NEXT. If not explicitly stated, its value is 1. If stated, it can be any number—positive or negative, even a decimal value. A zero would make the FOR-NEXT loop an *infinite loop*.

machine language for beginners

Richard Mansfield
Senior Editor

If you have a question about machine language, send a letter to ML Mailbag, COMPUTE!'s Gazette, 324 W. Wendover, Greensboro, NC 27408.

What Do You Need?

I am interested in learning machine language. Could you please print some hints to get me past the novice level?

The first thing to learn about ML is that it's not particularly difficult to learn. After a week or two with a good beginner's book which describes ML for your computer, you'll be surprised at how much you can accomplish.

You do need certain things, some tools of the trade. First, and most important, you'll want a quality *assembler*. It's a program which translates your ML commands into finished ML programs. It's best to get one which allows you to use *labels* so you can identify subroutines and important variables by name. That makes many things easier when you're writing ML programs. Also, assemblers which allow you to write your programs in BASIC mode (using the screen editor, line numbers, and so on, just as if you were writing a BASIC program) are probably the easiest to work with.

Another useful item is a *monitor* program. It's most helpful for debugging ML (and debugging is the only major aspect of ML which is more difficult than programming in BASIC). So you want the best monitor you can find. It's especially helpful if your monitor allows *single-stepping* and *breakpoints*, which are the ML equivalents of BASIC's TRACE and STOP. If you own a 128, it already has a monitor built in. VIC and 64 owners need to locate a monitor. There are several available commercially as well as in books, in magazines, and from user groups or online databases.

The final necessity is patience, especially with yourself and especially at the beginning. The first few days studying ML are spent in largely unrelieved darkness. But like other such challenges, the light goes on sooner than you expect.

How To Use The Flags

I have read about the various flags the computer uses, such as the interrupt flag, the carry flag, and the overflow flag. These flags are supposed to be in the status register. How do you access the status register and the individual flags? And how do you tell if a flag is up or down?

It's not really important to know the state of all the various flags; the computer will flip them up and down as necessary. There are several instructions in ML which do allow you to force a flag up or down: SED, for example, SEts the Decimal flag (puts it up). But, aside from the one exception we'll look at below, you don't need to directly move the flags.

Let's see how the computer (not the programmer) utilizes flags. The status register is a single byte, a special place where each bit within that status register byte can signify a *condition* within the computer. The available bits—the flags—are N, Z, C, I, D, and V: the Negative, Zero, Carry, Interrupt, Decimal, and Overflow flags. You can safely ignore the N, I, D, and V flags for most ML programming. The Z and C flags, however, are important enough to warrant a brief mention.

If you load the accumulator with a zero, as in LDA #0, the computer *automatically* sets (flings up) the zero flag. This flag is automatically tested by the BNE or BEQ instructions.

Here's how it works:

```
845 LDA #32
847 LDY #0
849 JSR $FFD2
852 DEY
853 BNE 849
855 RTS
```

This little program will print 256 space characters (#32) to your screen because the routine at $FFD2 prints whatever is in the accumulator. We put a 0 into the Y register to let it act as a counter. It will keep counting down from 255 until it hits 0. But, until it does hit 0, the Z flag will not have gone up, and the BNE (Branch if zero flag is Not Equal to zero) causes us to keep looping back to address 849 and printing another blank character. You, the programmer, aren't doing anything about that zero flag. But it is eventually flung up when DEY results in a 0 in the Y register. And that event, that setting of the Z flag, is what the BNE instruction has been sitting there waiting for. Finally, it can let your program pass through to the RTS instruction.

In other words, the flags fly up and down all the time during a program run, but you needn't worry about them at all. However, for technical reasons, you do need to SEC and CLC (directly SEt or CLear the Carry flag). All you need to remember is to CLC just before any addition and SEC just prior to any subtraction:

```
LDA #4
CLC
ADC #8
```

or

```
LDA #12
SEC
SBC #3
```

The correct result will then appear in the accumulator.

Useful WAITS

Andrew S. Wong

If you've discovered a clever time-saving technique or a brief but effective programming shortcut, send it to "Hints & Tips," c/o COMPUTE!'s Gazette. If we use it, we'll pay you $35. We regret that, due to the volume of items submitted, we cannot reply individually to submissions.

Commodore BASIC's WAIT statement can simplify the programming of key fetches and delays. It has the following format:

WAIT *address, mask1, mask2*

WAIT halts execution of the BASIC program until the contents of the memory address meet the conditions specified by the masks. Since most locations don't change on their own, WAIT is most useful for monitoring the registers of I/O devices and interrupt timers.

Masks are used to hide part of the byte from the WAIT statement. Since a byte is made of eight bits, it's possible to hold eight independent pieces of information in a byte. Using a mask, we can determine the state of a single bit. For example, if we wanted to know the value of bit 3 in memory location 49152, we could use this line:

```
PRINT PEEK(49152) AND 8
```

The value 8 is the mask. We use 8 to select bit 3 because $2^3 = 8$.

WAIT uses two masks. The contents of the specified memory location are XORed (eXclusive ORed) with the second mask (if one is supplied) and then ANDed with the first mask. If the result is zero, the comparison is repeated until it's nonzero.

Here's an example:

```
WAIT 653,4
```

On the Commodore 64, location 653 reflects the status of certain keys on the keyboard (more about this location later). Bit 2 of this location will be set to 1 if the CTRL key has been pressed, or to 0 if it hasn't been pressed. We use a mask value of 4, since the value of an *on* bit at bit position 2 is 4 (binary 100). In this case, the result of the test is either a 0 if CTRL has been pressed or 4 if it hasn't. Since the WAIT statement waits for a nonzero result, the statement WAIT 653,4 waits for the CTRL key to be pressed.

If you wanted to monitor two different bits, you'd add their values together. For example, to WAIT for any of bits 0–3 to be turned on, use a mask of 15 (1 + 2 + 4 + 8).

If you want to wait for a key to be released, you must supply a value for the *mask2* parameter (the exclusive-OR mask) to reverse the value of the bit. The following statement waits for CTRL to be released:

```
WAIT 653,4,4
```

I use WAIT to simplify the programming of time delays and the reading of keypresses. Here are some of the addresses I use with the WAIT statement:

198 holds the number of keys in the keyboard buffer. Location 208 serves the same purpose on the 128. The maximum value is 10.

197 holds the keyboard code of the key currently being pressed. Location 213 provides the same information on the 128. A value of 64 (88 on the 128) means that no keys are depressed.

653 holds flags for the SHIFT, CTRL, and Commodore keys. Location 211 provides similar information on the 128. A value of 1 indicates that SHIFT is being held down, a 2 indicates that the Commodore key is down, and a 4 indicates that CTRL is down. For the 128, a value of 8 indicates that the ALT key is being held down, and a 16 indicates that the CAPS LOCK key is down. If two or all three of the keys are being pressed, the value here is the sum of the individual key values. For example, if SHIFT and CTRL are held down together, this location will hold the value 5.

160–162 is the software jiffy clock which increments every 1/60 second. (The same locations are used in 128 mode.) Location 160 is the most significant byte, and location 162 is the least significant byte. The following chart shows how often the bits change. The times for location 160 are approximate.

Bit	Location 162	Location 161	Location 160
0	1/60 sec	4-4/15 sec	17 min
1	1/30 sec	8-8/15 sec	34 min
2	1/15 sec	17-1/15 sec	67 min
3	2/15 sec	34-2/15 sec	135 min
4	4/15 sec	68-4/15 sec	270 min
5	8/15 sec	136-8/15 sec	9 hrs
6	1-1/15 sec	273-1/15 sec	18 hrs
7	2-2/15 sec	546-2/15 sec	36 hrs

Applications

The following examples use the Commodore 64 locations. They also work on a Commodore 128 in 64 mode. For 128 mode, substitute the appropriate locations as listed above.

```
10 WAIT 198,15:GET A$
```

This line waits for a key to be pressed and stores that key in A$. This is equivalent to the line 10 GET A$:IF A$="" THEN 10.

```
10 WAIT 197,63:KEY=PEEK(197)
20 WAIT 197,64
```

Line 10 waits for any key to be pressed. Line 20 waits for all keys to be released.

```
10 WAIT 653,1
20 WAIT 653,1,1
```

Line 10 waits for SHIFT to be pressed, and 20 waits for it to be released. Line 20 alone could be used to add a pause feature in a game.

```
10 POKE 162,0:WAIT 162,32
```

This makes a delay that's approximately 1/2 second long.

```
20 POKE 161,0:POKE 162,0:WAIT 161,1
20 TI$="000000":WAIT 161,1
```

Either of these two lines will create a delay of 4-4/15 seconds.

What Is Memory?

Todd Heimarck
Assistant Editor

Everyone knows what memory is. That's the place programs go when you load them. Variables go there, too; if you have too many variables, you'll run out of memory. You can POKE numbers into memory and things will happen, like the screen changing colors. The screen itself uses 1000 bytes of memory. BASIC is already in memory when you turn on the computer. Sometimes you have to protect memory, so BASIC programs don't interfere with machine language programs. Some sections of memory contain pointers and vectors.

So what is memory? From the fragmentary description above, you might think that it's a sort of large, messy closet that holds a variety of useful items. Here's a pointer; there's a variable. And in this corner we see a character set.

This metaphor, the memory closet, can be misleading. A description of a program might say that a certain sprite is stored at location 832, but if you PRINT PEEK(832) and PEEK the 62 locations following it, you'll probably see some zeros, some 255s, and some other numbers. They're just numbers: Where's the sprite shape?

That's all you'll ever find in memory—just a bunch of numbers. Various tracts of memory serve different purposes at different times. The memory that holds a machine language program now might hold sprite shapes or a hi-res screen later.

Peering Inside

Let's dig around in memory and see what we can find. Before we begin, you'll need to type in a short machine language program ("Memory Display," found in the program listings section). It must be entered using "MLX," the machine language editor found elsewhere in this issue. After loading and running MLX, enter the following information:

Starting Address: C000
Ending Address: C19F

After typing it in, save a copy with the name MEMDISPLAY. Then LOAD "MEMDISPLAY",8,1 (substitute ,1,1 if you're using tape). The program is written for the 64, so you'll have to enter 64 mode to use it with a Commodore 128. When the program has finished loading, type NEW to reset important memory pointers; then activate Memory Display with SYS 49152.

You'll see the contents of 128 bytes of memory (locations $0800–$087F, decimal 2048–2175). The labels in the left-hand column are the memory addresses. They're followed by eight bytes (in hex) and the eight equivalent ASCII values printed in reverse.

The five commands are listed at the top. The plus (+) and minus (−) keys allow you to move forward or backward in memory in steps of 128 bytes. The zero (0) key displays the same section of memory again. The English pound (£) key allows you to enter a new memory address in hex. And Q is for quit.

The ML Program And Screen Memory

Press the £ key and enter C000. The numbers A9, 00, 85, FB, and so on are part of the Memory Display machine language routine that you typed in. If you compare what's on the screen to the program listing from the magazine, the first eight columns should be the same.

Press the plus key a couple of times. At $C15A, you'll see the following series of bytes:

```
93 12 30 92 3D 41 47 41 49 4E 20
```

These numbers are part of the program, but they're not machine language. The number $93—equivalent to CHR$(147)—is the character code for the clear-screen character. The $12 is the character code for reverse-on, the $30 is the character code for 0, and $92 is reverse-off. And the rest of that line spells =*AGAIN*. If you compare the characters on the right side of the screen with the message at the top, you'll see the connection.

The screen is located at 1024 (hex $0400), so press £ again and enter 0400. This time, the letters for *AGAIN* show up as 01 07 01 09 0E—screen codes instead of character codes. If you use the plus and minus keys to move forward and back, the screen will display the screen codes for the characters on the screen.

More Messages

If you move around in memory, you'll find many more messages. At $A09E, for example, you'll see a series of characters that spell *enDfoRnexTdatA*, plus a lot more. This is the keyword lookup table. When you enter a command, the 64 has to search through the list for a match. Note that the last character is shifted (press the Commodore and SHIFT keys at the same time to toggle into uppercase/lowercase mode). Using a shifted character at the end is one way to mark the division between keywords.

Move up to $A19E and you'll see another list: *too many fileSfile opeNfile not opeN*—these are the error messages. They, too, end with a shifted character. Another area that contains characters is $E460.

Here's one more experiment to try. Press £ and then enter 00A0. The first three bytes are the jiffy clock, which is constantly being updated. Press the zero key several times and the third byte will change. About once every four seconds the second byte will change.

Don't scratch the Memory Display program. Next month, we'll take a look at a BASIC program.

See program listing on page 110.

How To Type In *COMPUTE!'s GAZETTE* Programs

Each month, COMPUTE!'s GAZETTE publishes programs for the Commodore 128, 64, Plus/4, 16, and VIC-20. Each program is clearly marked by title and version. Be sure to type in the correct version for your machine. All 64 programs run on the 128 in 64 mode. Be sure to read the instructions in the corresponding article. This can save time and eliminate any questions which might arise after you begin typing.

We frequently publish two programs designed to make typing easier: The Automatic Proofreader, and MLX, designed for entering machine language programs.

When entering a BASIC program, be especially careful with DATA statements as they are extremely sensitive to errors. A mistyped number in a DATA statement can cause your machine to "lock up" (you'll have no control over the computer). If this happens, the only recourse is to turn your computer off then back on, erasing whatever was in memory. So be sure to *save a copy of your program before you run it.* If your computer crashes, you can always reload the program and look for the error.

Special Characters

Most of the programs listed in each issue contain special control characters. To facilitate typing in any programs from the GAZETTE, use the following listing conventions.

The most common type of control characters in our listings appear as words within braces: {DOWN} means to press the cursor down key; {5 SPACES} means to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing another key), the character is underlined. For example, A̲ means hold down the SHIFT key and press A. You may see strange characters on your screen, but that's to be expected. If you find a number followed by an underlined key enclosed in braces (for example, {8 A̲}), type the key as many times as indicated (in our example, enter eight SHIFTed A's).

If a key is enclosed in special brackets, Ɛ Ʒ, hold down the Commodore key (at the lower left corner of the keyboard) and press the indicated character.

Rarely, you'll see a single letter of the alphabet enclosed in braces. This can be entered on the Commodore 64 by pressing the CTRL key while typing the letter in braces. For example, {A} means to press CTRL-A.

The Quote Mode

Although you can move the cursor around the screen with the CRSR keys, often a programmer will want to move the cursor under program control. This is seen in examples such as {LEFT} and {HOME} in the program listings. The only way the computer can tell the difference between direct and programmed cursor control is *the quote mode.*

Once you press the quote key, you're in quote mode. This mode can be confusing if you mistype a character and cursor left to change it. You'll see a reverse video character (a graphics symbol for cursor left). In this case, you can use the DELete key to back up and edit the line. Type another quote and you're out of quote mode. If things really get confusing, you can exit quote mode simply by pressing RETURN. Then just cursor up to the mistyped line and fix it.

When You Read:	Press:	See:
{CLR}	SHIFT CLR/HOME	
{HOME}	CLR/HOME	
{UP}	SHIFT ↑ CRSR ↓	
{DOWN}	↑ CRSR ↓	
{LEFT}	SHIFT ← CRSR →	
{RIGHT}	← CRSR →	
{RVS}	CTRL 9	
{OFF}	CTRL 0	
{BLK}	CTRL 1	
{WHT}	CTRL 2	
{RED}	CTRL 3	
{CYN}	CTRL 4	

When You Read:	Press:	See:
{PUR}	CTRL 5	
{GRN}	CTRL 6	
{BLU}	CTRL 7	
{YEL}	CTRL 8	
{ F1 }	f1	
{ F2 }	SHIFT f1	
{ F3 }	f3	
{ F4 }	SHIFT f3	
{ F5 }	f5	
{ F6 }	SHIFT f5	
{ F7 }	f7	
{ F8 }	SHIFT f7	

When You Read:	Press:	See:
←	←	
↑̲	SHIFT ↑	

For Commodore 64 Only

When You Read:	Press:	See:
Ɛ 1 Ʒ	COMMODORE 1	
Ɛ 2 Ʒ	COMMODORE 2	
Ɛ 3 Ʒ	COMMODORE 3	
Ɛ 4 Ʒ	COMMODORE 4	
Ɛ 5 Ʒ	COMMODORE 5	
Ɛ 6 Ʒ	COMMODORE 6	
Ɛ 7 Ʒ	COMMODORE 7	
Ɛ 8 Ʒ	COMMODORE 8	

The Automatic Proofreader

Philip I. Nelson, Assistant Editor

"The Automatic Proofreader" helps you type in program listings for the 128, 64, Plus/4, 16, and VIC-20 and prevents nearly every kind of typing mistake.

Type in the Proofreader *exactly* as listed. Since the program can't check itself, type carefully to avoid mistakes. Don't omit any lines, even if they contain unfamiliar commands. After finishing, save a copy or two on disk or tape before running it. This is important because the Proofreader erases the BASIC portion of itself when you run it, leaving only the machine language portion in memory.

Next, type RUN and press RETURN. After announcing which computer it's running on, the Proofreader displays the message "Proofreader Active". Now you're ready to type in a BASIC program.

Every time you finish typing a line and press RETURN, the Proofreader displays a two-letter checksum in the upper-left corner of the screen. Compare this result with the two-letter checksum printed to the left of the line in the program listing. If the letters match, it's almost certain the line was typed correctly. If the letters don't match, check for your mistake and correct the line.

The Proofreader ignores spaces not enclosed in quotes, so you can omit or add spaces between keywords and still see a matching checksum. However, since spaces inside quotes are almost always significant, the Proofreader pays attention to them. For example, **10 PRINT"THIS IS BASIC"** will generate a different checksum than **10 PRINT"THIS ISBA SIC"**.

A common typing error is transposition—typing two successive characters in the wrong order, like PIRNT instead of PRINT or 64378 instead of 64738. The Proofreader is sensitive to the *position* of each character within the line and thus catches transposition errors.

The Proofreader does *not* accept keyword abbreviations (for example, ? instead of PRINT). If you prefer to use abbreviations, you can still check the line by LISTing it after typing it in, moving the cursor back to the line, and pressing RETURN. LISTing the line substitutes the full keyword for the abbreviation and allows the Proofreader to work properly. The same technique works for rechecking programs you've already typed in.

If you're using the Proofreader on the Commodore 128, Plus/4, or 16, *do not perform any GRAPHIC commands while the Proofreader is active.* When you perform a command like GRAPHIC 1, the computer moves everything at the start of BASIC program space—including the Proofreader—to another memory area, causing the Proofreader to crash. The same thing happens if you *run* any program with a GRAPHIC command while the Proofreader is in memory.

Though the Proofreader doesn't interfere with other BASIC operations, it's a good idea to disable it before running another program. However, the Proofreader is purposely difficult to dislodge: It's not affected by tape or disk operations, or by pressing RUN/STOP–RESTORE. The simplest way to disable it is to turn the computer off then on. A gentler method is to SYS to the computer's built-in reset routine (SYS 65341 for the 128, 64738 for the 64, 65526 for the Plus/4 and 16, and 64802 for the VIC). These reset routines erase any program in memory, so be sure to save the program you're typing in before entering the SYS command.

If you own a Commodore 64, you may already have wondered whether the Proofreader works with other programming utilities like "MetaBASIC." The answer is generally yes, *if you're using a 64 and activate the Proofreader after installing the other utility.* For example, first load and activate MetaBASIC, then load and run the Proofreader.

When using the Proofreader with another utility, you should disable *both* programs before running a BASIC program. While the Proofreader seems unaffected by most utilities, there's no way to promise that it will work with any and every combination of utilities you might want to use. The more utilities activated, the more fragile the system becomes.

The New Automatic Proofreader

```
10 VEC=PEEK(772)+256*PEEK(773)
   :LO=43:HI=44
20 PRINT "AUTOMATIC PROOFREADE
   R FOR ";:IF VEC=42364 THEN
   {SPACE}PRINT "C-64"
30 IF VEC=50556 THEN PRINT "VI
   C-20"
40 IF VEC=35158 THEN GRAPHIC C
   LR:PRINT "PLUS/4 & 16"
50 IF VEC=17165 THEN LO=45:HI=
   46:GRAPHIC CLR:PRINT"128"
60 SA=(PEEK(LO)+256*PEEK(HI))+
   6:ADR=SA
70 FOR J=0 TO 166:READ BYT:POK
   E ADR,BYT:ADR=ADR+1:CHK=CHK
   +BYT:NEXT
80 IF CHK<>20570 THEN PRINT "*
   ERROR* CHECK TYPING IN DATA
    STATEMENTS":END
90 FOR J=1 TO 5:READ RF,LF,HF:
   RS=SA+RF:HB=INT(RS/256):LB=
   RS-(256*HB)
100 CHK=CHK+RF+LF+HF:POKE SA+L
   F,LB:POKE SA+HF,HB:NEXT
110 IF CHK<>22054 THEN PRINT "
   *ERROR* RELOAD PROGRAM AND
   {SPACE}CHECK FINAL LINE":EN
   D
120 POKE SA+149,PEEK(772):POKE
    SA+150,PEEK(773)
130 IF VEC=17165 THEN POKE SA+
   14,22:POKE SA+18,23:POKESA+
   29,224:POKESA+139,224
140 PRINT CHR$(147);CHR$(17);"
   PROOFREADER ACTIVE":SYS SA
150 POKE HI,PEEK(HI)+1:POKE (P
   EEK(LO)+256*PEEK(HI))-1,0:N
   EW
160 DATA 120,169,73,141,4,3,16
   9,3,141,5,3
170 DATA 88,96,165,20,133,167,
   165,21,133,168,169
180 DATA 0,141,0,255,162,31,18
   1,199,157,227,3
190 DATA 202,16,248,169,19,32,
   210,255,169,18,32
200 DATA 210,255,160,0,132,180
   ,132,176,136,230,180
210 DATA 200,185,0,2,240,46,20
   1,34,208,8,72
220 DATA 165,176,73,255,133,17
   6,104,72,201,32,208
230 DATA 7,165,176,208,3,104,2
   08,226,104,166,180
240 DATA 24,165,167,121,0,2,13
   3,167,165,168,105
250 DATA 0,133,168,202,208,239
   ,240,202,165,167,69
260 DATA 168,72,41,15,168,185,
   211,3,32,210,255
270 DATA 104,74,74,74,74,168,1
   85,211,3,32,210
280 DATA 255,162,31,189,227,3,
   149,199,202,16,248
290 DATA 169,146,32,210,255,76
   ,86,137,65,66,67
300 DATA 68,69,70,71,72,74,75,
   77,80,81,82,83,88
310 DATA 13,2,7,167,31,32,151,
   116,117,151,128,129,167,136
   ,137
```

MLX Machine Language Entry Program For Commodore 64

Ottis Cowper, Technical Editor

"MLX" is a labor-saving utility that allows almost fail-safe entry of Commodore 64 machine language programs.

Type in and save some copies of MLX—you'll want to use it to enter future ML programs from COMPUTE!'s GAZETTE. When you're ready to enter an ML program, load and run MLX. It asks you for a starting address and an ending address. These addresses appear in the article accompanying the MLX-format program listing you're typing.

If you're unfamiliar with machine language, the addresses (and all other values you enter in MLX) may appear strange. Instead of the usual decimal numbers you're accustomed to, these numbers are in *hexadecimal*—a base 16 numbering system commonly used by ML programmers. Hexadecimal—hex for short—includes the numerals 0–9 and the letters A–F. But don't worry—even if you know nothing about ML or hex, you should have no trouble using MLX.

After you enter the starting and ending addresses, you'll be offered the option of clearing the workspace. Choose this option if you're starting to enter a new listing. If you're continuing a listing that's partially typed from a previous session, don't choose this option.

A functions menu will appear. The first option in the menu is ENTER DATA. If you're just starting to type in a program, pick this. Press the E key, and type the first number in the first line of the program listing. If you've already typed in part of a program, type the line number where you left off typing at the end of the previous session (be sure to load the partially completed program before you resume entry). In any case, make sure the address you enter corresponds to the address of a line in the listing you are entering. Otherwise, you'll be unable to enter the data correctly. If you pressed E by mistake, you can return to the command menu by pressing RETURN alone when asked for the address. (You can get back to the menu from most options by pressing RETURN with no other input.)

Entering A Listing

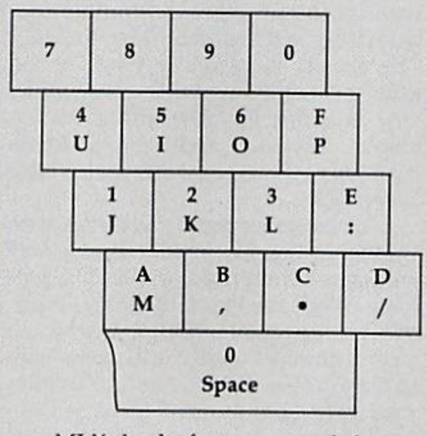
Once you're in Enter mode, MLX prints the address for each program line for you. You then type in all nine numbers on that line, beginning with the first two-digit number after the colon (:). Each line represents eight data bytes and a checksum. Although an MLX-format listing appears similar to the "hex dump" listings from a machine language monitor program, the extra checksum number on the end allows MLX to check your typing.

When you enter a line, MLX recalculates the checksum from the eight bytes and the address and compares this value to the number from the ninth column. If the values match, you'll hear a bell tone, the data will be added to the workspace area, and the prompt for the next line of data will appear. But if MLX detects a typing error, you'll hear a low buzz and see an error message. The line will then be redisplayed for editing.

Invalid Characters Banned

Only a few keys are active while you're entering data, so you may have to unlearn some habits. You *do not* type spaces between the columns; MLX automatically inserts these for you. You *do not* press RETURN after typing the last number in a line; MLX automatically enters and checks the line after you type the last digit.

Only the numerals 0–9 and the letters A–F can be typed in. If you press any other key (with some exceptions noted below), you'll hear a warning buzz. To simplify typing, the numeric keypad modification from the March 1986 "Bug-Swatter" column is now incorporated in the listing. The keypad is active only while entering data. Addresses must be entered with the normal letter and number keys. The figure below shows the keypad configuration:



MLX checks for transposed characters. If you're supposed to type in A0 and instead enter 0A, MLX will catch your mistake. There is one error that can slip past MLX: Because of the checksum formula used, MLX won't notice if you accidentally type FF in place of 00, and vice versa. And there's a very slim chance that you could garble a line and still end up with a combination of characters that adds up to the proper checksum. However, these mistakes should not occur if you take reasonable care while entering data.

Editing Features

To correct typing mistakes before finishing a line, use the INST/DEL key to delete the character to the left of the cursor. (The cursor-left key also deletes.) If you mess up a line really badly, press CLR/HOME to start the line over. The RETURN key is also active, but only before any data is typed on a line. Pressing RETURN at this point returns you to the command menu. After you type a character of data, MLX disables RETURN until the cursor returns to the start of a line. Remember, you can press CLR/HOME to quickly get to a line number prompt.

More editing features are available when correcting lines in which MLX has detected an error. To make corrections in a line that MLX has redisplayed for editing, compare the line on the screen with the one printed in the listing, then move the cursor to the mistake and type the correct key. The cursor left and right keys provide the normal cursor controls. (The INST/DEL key now works as an alternative cursor-left key.) You cannot move left beyond the first character in the line. If you try to move beyond the rightmost character, you'll reenter the line. During editing, RETURN is active; pressing it tells MLX to recheck the line. You can press the CLR/HOME key to clear the entire line if you want to start from scratch, or if you want to get to a line number prompt to use RETURN to get back to the menu.

Display Data

The second menu choice, DISPLAY DATA, examines memory and shows the contents in the same format as the program listing (including the checksum). When you press D, MLX asks you for a starting address. Be sure that the starting address you give corresponds to a line number in the listing. Otherwise, the checksum display will be meaningless. MLX displays program lines until it reaches the end of the program, at which point the menu is redisplayed. You can pause the display by pressing the space bar. (MLX finishes printing the current line before halting.) Press space again to restart the display. To break out of the display and get back to the menu before the ending address is reached, press RETURN.

Other Menu Options

Two more menu selections let you save programs and load them back into the computer. These are SAVE FILE and LOAD FILE; their operation is quite straightforward. When you press S or L, MLX asks you for the filename. You'll then be asked to press either D or T to select disk or tape.

You'll notice the disk drive starting and stopping several times during a load or save. Don't panic; this is normal behavior. MLX opens and reads from or writes to the file instead of using the usual LOAD and SAVE commands. Disk users should also note that the drive prefix 0: is automatically added to the filename (line 750), so this should *not* be included when entering the name. This also precludes the use of @ for Save-with-Replace, so remember to give each version you save a different name.

Remember that MLX saves the entire workspace area from the starting address to the ending address, so the save or load may take longer than you might expect if you've entered only a small amount of data from a long listing. When saving a partially completed listing, make sure to note the address where you stopped typing so you'll know where to resume entry when you reload.

MLX reports the standard disk or tape error messages if any problems are detected during the save or load. (Tape users should bear in mind that Commodore computers are never able to detect errors during a save to tape.) MLX also has three special load error messages: INCORRECT STARTING ADDRESS, which means the file you're trying to load does not have the starting address you specified when you ran MLX; LOAD ENDED AT *address*, which means the file you're trying to load ends before the ending address you specified when you started MLX; and TRUNCATED AT ENDING ADDRESS, which means the file you're trying to load extends beyond the ending address you specified when you started MLX. If you see one of these messages and feel certain that you've loaded the right file, exit and rerun MLX, being careful to enter the correct starting and ending addresses.

The QUIT menu option has the obvious effect—it stops MLX and enters BASIC. The RUN/STOP key is disabled, so the Q option lets you exit the program without turning off the computer. (Of course, RUN/STOP-RESTORE also gets you out.) You'll be asked for verification; press Y to exit to BASIC, or any other key to return to the menu. After quitting, you can type RUN again and reenter MLX without losing your data, as long as you don't use the clear workspace option.

The Finished Product

When you've finished typing all the data for an ML program and saved your work, you're ready to see the results. The instructions for loading and using the finished product vary from program to program. Some ML programs are designed to be loaded and run like BASIC programs, so all you need to type is LOAD *"filename"*,8 for disk or LOAD *"filename"* for tape, and then RUN. Such programs will usually have a starting address of 0801 for the 64. Other programs must be reloaded to specific addresses with a command such as LOAD *"filename"*,8,1 for disk or LOAD *"filename"*,1,1 for tape, then started with a SYS to a particular memory address. On the Commodore 64, the most common starting address for such programs is 49152, which corresponds to MLX address C000. In either case, you should always refer to the article which accompanies the ML listing for information on loading and running the program.

An Ounce Of Prevention

By the time you finish typing in the data for a long ML program, you may have several hours invested in the project. Don't take chances—use our "Automatic Proofreader" to type the new MLX, and then test your copy *thoroughly* before first using it to enter any significant amount of data. Make sure all the menu options work as they should. Enter fragments of the program starting at several different addresses, then use the Display option to verify that the data has been entered correctly. And be sure to test the Save and Load options several times to insure that you can recall your work from disk or tape. Don't let a simple typing error in the new MLX cost you several nights of hard work.

MLX For Commodore 64

```
SS 10 REM VERSION 1.1: LINES 8
      30,950 MODIFIED, LINES 4
      85-487 ADDED
EK 100 POKE 56,50:CLR:DIM IN$,
      I,J,A,B,A$,B$,A(7),N$
DM 110 C4=48:C6=16:C7=7:Z2=2:Z
      4=254:Z5=255:Z6=256:Z7=
      127
CJ 120 FA=PEEK(45)+Z6*PEEK(46)
      :BS=PEEK(55)+Z6*PEEK(56
      ):H$="0123456789ABCDEF"
SB 130 R$=CHR$(13):L$="{LEFT}"
      :S$=" ":D$=CHR$(20):Z$=
      CHR$(0):T$="{13 RIGHT}"
CQ 140 SD=54272:FOR I=SD TO SD
      +23:POKE I,0:NEXT:POKE
      {SPACE}SD+24,15:POKE 78
      8,52
FC 150 PRINT"{CLR}"CHR$(142)CH
      R$(8):POKE 53280,15:POK
      E 53281,15
EJ 160 PRINT T$" {RED}{RVS}
      {2 SPACES}[8 @]
      {2 SPACES}"SPC(28)"
      {2 SPACES}{OFF}{BLU} ML
      X II {RED}{RVS}
      {2 SPACES}"SPC(28)"
      {12 SPACES}{BLU}"
FR 170 PRINT"{3 DOWN}
      {3 SPACES}COMPUTE!'S MA
      CHINE LANGUAGE EDITOR
      {3 DOWN}"
JB 180 PRINT"{BLK}STARTING ADD
      RESS[4]";:GOSUB300:SA=A
      D:GOSUB1040:IF F THEN18
      0
GF 190 PRINT"{BLK}{2 SPACES}EN
      DING ADDRESS[4]";:GOSUB
      300:EA=AD:GOSUB1030:IF
      {SPACE}F THEN190
KR 200 INPUT"{3 DOWN}{BLK}CLEA
      R WORKSPACE [Y/N][4]";A
      $:IF LEFT$(A$,1)<>"Y"TH
      EN220
PG 210 PRINT"{2 DOWN}{BLU}WORK
      ING...";:FORI=BS TO BS+
      EA-SA+7:POKE I,0:NEXT:P
      RINT"DONE"
DR 220 PRINTTAB(10)"{2 DOWN}
      {BLK}{RVS} MLX COMMAND
      {SPACE}MENU {DOWN}[4]":
      PRINT T$"{RVS}E{OFF}NTE
      R DATA"
BD 230 PRINT T$"{RVS}D{OFF}ISP
      LAY DATA":PRINT T$"
      {RVS}L{OFF}OAD FILE"
JS 240 PRINT T$"{RVS}S{OFF}AVE
       FILE":PRINT T$"{RVS}Q
      {OFF}UIT{2 DOWN}{BLK}"
JH 250 GET A$:IF A$=N$ THEN250
HK 260 A=0:FOR I=1 TO 5:IF A$=
      MID$("EDLSQ",I,1)THEN A
      =I:I=5
FD 270 NEXT:ON A GOTO420,610,6
      90,700,280:GOSUB1060:GO
      TO250
EJ 280 PRINT"{RVS} QUIT ":INPU
      T"{DOWN}[4]ARE YOU SURE
       [Y/N]";A$:IF LEFT$(A$,
      1)<>"Y"THEN220
EM 290 POKE SD+24,0:END
JX 300 IN$=N$:AD=0:INPUTIN$:IF
      LEN(IN$)<>4THENRETURN
KF 310 B$=IN$:GOSUB320:AD=A:B$
      =MID$(IN$,3):GOSUB320:A
      D=AD*256+A:RETURN
PP 320 A=0:FOR J=1 TO 2:A$=MID
      $(B$,J,1):B=ASC(A$)-C4+
      (A$>"@")*C7:A=A*C6+B
JA 330 IF B<0 OR B>15 THEN AD=
      0:A=-1:J=2
GX 340 NEXT:RETURN
CH 350 B=INT(A/C6):PRINT MID$(
      H$,B+1,1);:B=A-B*C6:PRI
      NT MID$(H$,B+1,1);:RETU
      RN
RR 360 A=INT(AD/Z6):GOSUB350:A
      =AD-A*Z6:GOSUB350:PRINT
      ":";
BE 370 CK=INT(AD/Z6):CK=AD-Z4*
      CK+Z5*(CK>Z7):GOTO390
PX 380 CK=CK*Z2+Z5*(CK>Z7)+A
```

```
JC 390 CK=CK+Z5*(CK>Z5):RETURN
QS 400 PRINT"{DOWN}STARTING AT
       {4}";:GOSUB300:IF IN$<>
       N$ THEN GOSUB1030:IF F
       {SPACE}THEN400
EX 410 RETURN
HD 420 PRINT"{RVS} ENTER DATA
       {SPACE}":GOSUB400:IF IN
       $=N$ THEN220
JK 430 OPEN3,3:PRINT
SK 440 POKE198,Ø:GOSUB360:IF F
        THEN PRINT IN$:PRINT"
       {UP}{5 RIGHT}";
GC 450 FOR I=Ø TO 24 STEP 3:B$
       =S$:FOR J=1 TO 2:IF F T
       HEN B$=MID$(IN$,I+J,1)
HA 460 PRINT"{RVS}"B$L$;:IF I<
       24THEN PRINT"{OFF}";
HD 470 GET A$:IF A$=N$ THEN470
FK 480 IF(A$>"/"ANDA$<":")OR(A
       $>"@"ANDA$<"G")THEN540
GS 485 A=-(A$="M")-2*(A$=",")-
       3*(A$=".")-4*(A$="/")-5
       *(A$="J")-6*(A$="K")
FX 486 A=A-7*(A$="L")-8*(A$=":
       ")-9*(A$="U")-10*(A$="I
       ")-11*(A$="O")-12*(A$="
       P")
CM 487 A=A-13*(A$=S$):IF A THE
       N A$=MID$("ABCD123E456F
       Ø",A,1):GOTO 540
MP 490 IF A$=R$ AND((I=Ø)AND(J
       =1)OR F)THEN PRINT B$;:
       J=2:NEXT:I=24:GOTO550
KC 500 IF A$="{HOME}" THEN PRI
       NT B$:J=2:NEXT:I=24:NEX
       T:F=Ø:GOTO440
MX 510 IF(A$="{RIGHT}")ANDF TH
       ENPRINT B$L$;:GOTO540
GK 520 IF A$<>L$ AND A$<>D$ OR
       ((I=Ø)AND(J=1))THEN GOS
       UB1060:GOTO470
HG 530 A$=L$+S$+L$:PRINT B$L$;
       :J=2-J:IF J THEN PRINT
       {SPACE}L$;:I=I-3
QS 540 PRINT A$;:NEXT J:PRINT
       {SPACE}S$;
PM 550 NEXT I:PRINT:PRINT"{UP}
       {5 RIGHT}";:INPUT#3,IN$
       :IF IN$=N$ THEN CLOSE3:
       GOTO220
QC 560 FOR I=1 TO 25 STEP3:B$=
       MID$(IN$,I):GOSUB320:IF
        I<25 THEN GOSUB380:A(I
       /3)=A
PK 570 NEXT:IF A<>CK THEN GOSU
       B1060:PRINT"{BLK}{RVS}
       {SPACE}ERROR: REENTER L
       INE {4}":F=1:GOTO440
HJ 580 GOSUB1080:B=BS+AD-SA:FO
       R I=Ø TO 7:POKE B+I,A(I
       ):NEXT
QQ 590 AD=AD+8:IF AD>EA THEN C
       LOSE3:PRINT"{DOWN}{BLU}
       ** END OF ENTRY **{BLK}
       {2 DOWN}":GOTO700
GQ 600 F=Ø:GOTO440
QA 610 PRINT"{CLR}{DOWN}{RVS}
       {SPACE}DISPLAY DATA ":G
       OSUB400:IF IN$=N$ THEN2
       2Ø
RJ 620 PRINT"{DOWN}{BLU}PRESS:
        {RVS}SPACE{OFF} TO PAU
       SE, {RVS}RETURN{OFF} TO
        BREAK{4}{DOWN}"
KS 630 GOSUB360:B=BS+AD-SA:FOR
        I=BTO B+7:A=PEEK(I):GOS
       UB350:GOSUB380:PRINT S$
       ;
CC 640 NEXT:PRINT"{RVS}";:A=CK
       :GOSUB350:PRINT
KH 650 F=1:AD=AD+8:IF AD>EA TH
       ENPRINT"{DOWN}{BLU}** E
       ND OF DATA **":GOTO220
KC 660 GET A$:IF A$=R$ THEN GO
       SUB1080:GOTO220
EQ 670 IF A$=S$ THEN F=F+1:GOS
       UB1080
AD 680 ONFGOTO630,660,630
CM 690 PRINT"{DOWN}{RVS} LOAD
       {SPACE}DATA ":OP=1:GOTO
       710
PC 700 PRINT"{DOWN}{RVS} SAVE
       {SPACE}FILE ":OP=Ø
RX 710 IN$=N$:INPUT"{DOWN}FILE
       NAME{4}";IN$:IF IN$=N$
       {SPACE}THEN220
PR 720 F=Ø:PRINT"{DOWN}{BLK}
       {RVS}T{OFF}APE OR {RVS}
       D{OFF}ISK: {4}";
FP 730 GET A$:IF A$="T"THEN PR
       INT"T{DOWN}":GOTO880
HQ 740 IF A$<>"D"THEN730
HH 750 PRINT"D{DOWN}":OPEN15,8
       ,15,"IØ:":B=EA-SA:IN$="
       Ø:"+IN$:IF OP THEN810
SQ 760 OPEN 1,8,8,IN$+",P,W":G
       OSUB860:IF A THEN220
FJ 770 AH=INT(SA/256):AL=SA-(A
       H*256):PRINT#1,CHR$(AL)
       ;CHR$(AH);
PE 780 FOR I=Ø TO B:PRINT#1,CH
       R$(PEEK(BS+I));:IF ST T
       HEN800
FC 790 NEXT:CLOSE1:CLOSE15:GOT
       O940
GS 800 GOSUB1060:PRINT"{DOWN}
       {BLK}ERROR DURING SAVE:
       {4}":GOSUB860:GOTO220
MA 810 OPEN 1,8,8,IN$+",P,R":G
       OSUB860:IF A THEN220
GE 820 GET#1,A$,B$:AD=ASC(A$+Z
       $)+256*ASC(B$+Z$):IF AD
       <>SA THEN F=1:GOTO850
RX 830 FOR I=Ø TO B:GET#1,A$:P
       OKE BS+I,ASC(A$+Z$):IF(
       I<>B)AND ST THEN F=2:AD
       =I:I=B
FA 840 NEXT:IF ST<>64 THEN F=3
FQ 850 CLOSE1:CLOSE15:ON ABS(F
       >Ø)+1 GOTO960,970
SA 860 INPUT#15,A,A$:IF A THEN
        CLOSE1:CLOSE15:GOSUB10
       60:PRINT"{RVS}ERROR: "A
       $
GQ 870 RETURN
EJ 880 POKE183,PEEK(FA+2):POKE
       187,PEEK(FA+3):POKE188,
       PEEK(FA+4):IFOP=ØTHEN92
       Ø
HJ 890 SYS 63466:IF(PEEK(783)A
       ND1)THEN GOSUB1060:PRIN
       T"{DOWN}{RVS} FILE NOT
       {SPACE}FOUND ":GOTO690
CS 900 AD=PEEK(829)+256*PEEK(8
       3Ø):IF AD<>SA THEN F=1:
       GOTO970
SC 910 A=PEEK(831)+256*PEEK(83
       2)-1:F=F-2*(A<EA)-3*(A>
       EA):AD=A-AD:GOTO930
KM 920 A=SA:B=EA+1:GOSUB1010:P
       OKE780,3:SYS 63338
JF 930 A=BS:B=BS+(EA-SA)+1:GOS
       UB1010:ON OP GOTO950:SY
       S 63591
AE 940 GOSUB1080:PRINT"{BLU}**
        SAVE COMPLETED **":GOT
       O220
XP 950 POKE147,Ø:SYS 63562:IF
       {SPACE}ST>Ø THEN970
FR 960 GOSUB1080:PRINT"{BLU}**
        LOAD COMPLETED **":GOT
       O220
DP 970 GOSUB1060:PRINT"{BLK}
       {RVS}ERROR DURING LOAD:
       {DOWN}{4}":ON F GOSUB98
       Ø,990,1000:GOTO220
PP 980 PRINT"INCORRECT STARTIN
       G ADDRESS (";:GOSUB360:
       PRINT")":RETURN
GR 990 PRINT"LOAD ENDED AT ";:
       AD=SA+AD:GOSUB360:PRINT
       D$:RETURN
FD 1000 PRINT"TRUNCATED AT END
        ING ADDRESS":RETURN
RX 1010 AH=INT(A/256):AL=A-(AH
        *256):POKE193,AL:POKE1
        94,AH
FF 1020 AH=INT(B/256):AL=B-(AH
        *256):POKE174,AL:POKE1
        75,AH:RETURN
FX 1030 IF AD<SA OR AD>EA THEN
        1050
HA 1040 IF(AD>511 AND AD<40960
        )OR(AD>49151 AND AD<53
        248)THEN GOSUB1080:F=Ø
        :RETURN
HC 1050 GOSUB1060:PRINT"{RVS}
        {SPACE}INVALID ADDRESS
         {DOWN}{BLK}":F=1:RETU
        RN
AR 1060 POKE SD+5,31:POKE SD+6
        ,208:POKE SD,240:POKE
        {SPACE}SD+1,4:POKE SD+
        4,33
DX 1070 FOR S=1 TO 100:NEXT:GO
        TO1090
PF 1080 POKE SD+5,8:POKE SD+6,
        240:POKE SD,Ø:POKE SD+
        1,90:POKE SD+4,17
AC 1090 FOR S=1 TO 100:NEXT:PO
        KE SD+4,Ø:POKE SD,Ø:PO
        KE SD+1,Ø:RETURN
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Color Craft

Article on page 62.

Program 1: Color Craft—BASIC Section

```
QP 10 IFFL=0THENFL=1:LOAD "COLOR CRAFT.OBJ",8,1
RR 20 FL=2:POKE56,32:CLR:DIMFP(2,9),BAR(10),SC(9),MP(2,9)
EQ 30 POKE2040,13:POKE2042,253:POKE2043,254:POKE2044,255
ER 40 DIMCO(9):CO(1)=1:CO(2)=7:CO(3)=5:CO(4)=6:CO(5)=0:CO(6)=2:CO(7)=14
AM 50 CO(8)=10:CO(9)=13
XS 60 DIMS1(9),S2(9),S3(2),S4(2)
HQ 70 S1(1)=01:S2(1)=197:S1(2)=129:S2(2)=198:S1(3)=129:S2(3)=196
RS 80 S1(4)=65:S2(4)=196:S1(5)=193:S2(5)=196:S1(6)=1:S2(6)=196
CH 90 S1(7)=193:S2(7)=197:S1(8)=129:S2(8)=197:S1(9)=65:S2(9)=197
AA 100 S3(1)=1:S4(1)=198:S3(2)=65:S4(2)=198:POKE53242,63
JB 110 CO(0)=3:S1(0)=S1(1):S2(0)=S2(1)
QJ 120 V=53248:POKEV+16,0:NR=1:POKEV+29,0:POKEV+23,0
BS 130 POKE53276,PEEK(53276)OR(2↑0)
MQ 140 BAR(1)=1:BAR(2)=2:BAR(3)=4:BAR(4)=14:BAR(5)=5:BAR(6)=6:BAR(7)=7
RD 150 BAR(8)=10:BAR(9)=11:BAR(10)=13:POKE53280,14
AD 160 FORI=1TO9:SC(I)=CO(I):NEXT:POKE2045,14:POKE2046,15
QJ 170 POKE53245,128:POKE53246,3:POKE53243,85:POKE53244,201:SYS50944
RS 180 POKE53245,192:POKE53246,3:POKE53243,149:POKE53244,201:SYS50944
BP 190 POKEV+16,96:POKEV+10,43:POKEV+12,43:POKEV+11,59:POKEV+13,82:
RF 200 POKEV+45,0:POKEV+44,0:NH=0
BH 210 BASE=8192:POKE53272,PEEK(53272)OR8
JS 220 POKE53265,PEEK(53265)OR32:POKE53270,PEEK(53270)OR16:POKE53281,3
KR 230 POKE251,0:POKE252,32:POKE253,64:POKE254,33:POKE49152,255:SYS49153
SC 240 POKE251,64:POKE252,33:POKE253,64:POKE254.63:POKE49152,0:SYS49153
HG 250 POKE251,0:POKE252,4:POKE253,232:POKE254,7:POKE49152,0:SYS49153
QC 260 POKE251,0:POKE252,216:POKE253,231:POKE254,219:POKE49152,0:SYS49153
RF 270 CR=14:GOSUB1290
MR 280 POKE251,0:POKE252,62:POKE253,64:POKE254,63:POKE49152,255:SYS49153
KA 290 L=1:FORI=0TO9:FORJ=0TO3:POKE56256+I*4+J,BAR(L):NEXTJ:L=L+1:NEXTI
GB 300 FORBY=8768TO14848STEP320
SM 310 LY=INT(BY-BASE)/8+1024:POKELY,96
RE 320 FORI=0TO7:POKEBY+I,PEEK(BY+I)OR64:NEXT:NEXT
AH 330 FORBY=14599TO14853STEP8:POKEBY,255
RC 340 LY=INT(BY-BASE)/8+55296:POKELY,6:NEXT
FA 350 FORBY=14598TO14852STEP8:POKEBY,255
EQ 360 LY=INT(BY-BASE)/8+55296:POKELY,6:NEXT
CG 370 L=16191:FORI=0TO39:POKEL-(I*8),170:NEXT
PH 380 FORI=1TO9:CO(I)=SC(I):NEXT
SC 390 POKE53245,64:POKE53246,63:POKE53243,193:POKE53244,198:SYS50944
DR 400 POKEV+41,0:POKEV+42,0:POKEV+43,0
AG 410 POKE53245,128:POKE53246,63:POKE53243,S3(1):POKE53244,S4(1):SYS50944
RS 420 POKE53245,192:POKE53246,63:POKE53243,S3(2):POKE53244,S4(2):SYS50944
FJ 430 POKEV+6,30:POKEV+7,220:POKEV+8,70:POKEV+9,220:POKEV+21,120
DA 440 GOSUB1040:POKE49233,3
RS 450 FORSB=NHTO9:POKEV+16,96
GF 460 NY=FP(2,SB):NX=FP(1,SB):IFNX<256THEN480
CS 470 POKEV+16,97:NX=NX-255
GC 480 POKE53285,CO(SB)
JC 490 POKE53245,64:POKE53246,3:POKE53243,S1(SB):POKE53244,S2(SB):SYS50944
FB 500 POKEV,NX:POKEV+1,NY:POKE49189,0:SYS49185
JA 510 NEXTSB:NH=1:POKE49233,0
MQ 520 FL=9
GH 530 POKEV+4,255:POKEV+5,105:POKEV+16,96
AX 540 POKE51207,61:POKE51350,239:POKE49189,2:POKE251,4:POKE252,208
CK 550 POKEV+21,PEEK(V+21)OR4
RB 560 SYS51011
FK 570 IFPEEK(50978)<>0THEN560
FC 580 FORI=1TO300:NEXT
KK 590 X=PEEK(V+4)+24:Y=PEEK(V+5)+10:IF(PEEK(V+16)AND4)>0THENX=X+255
CK 600 IFY>240THEN870
XQ 610 IFX>255THEN680
JC 620 IFY<FP(2,7)-4THEN530
SF 630 IFX<70THENPOKEV+21,0:FL=9:POKE53280,14:GOTO220
RQ 640 IFX<FP(1,6)THEN1320
QP 650 FORSB=7TO9:IFX<FP(1,SB)THEN730
KP 660 NEXT
HX 670 SB=10:GOTO730
HQ 680 IFX<275THEN620
FM 690 IFY<100THEN1110
CK 700 FORSB=2TO5:IFY<FP(2,SB)THEN730
GR 710 NEXT
QM 720 SB=10:IFX>FP(2,9)+25THENSB=6
BK 730 SB=SB-1:POKE53245,64:POKE53246,3:POKE53243,S1(SB):POKE53244,S2(SB):SYS50944
GC 740 IFSB=5THEN970
XR 750 IFFL=10THENGOSUB900
DX 760 POKEV+1,FP(2,SB):NX=FP(1,SB):IFNX<256THEN780
KF 770 POKEV+16,PEEK(V+16)OR1:NX=NX-255
XH 780 POKEV,NX:POKE53285,CO(SB)
QA 790 POKEV+21,(PEEK(V+21)AND251)OR1
DS 800 POKE49189,0:POKE251,0:POKE252,208:POKE51207,0:POKE51350,196
JS 810 POKEV+1,MP(2,SB):NX=MP(1,SB):POKEV+16,PEEK(V+16)AND254:IFNX<256THEN830
AH 820 POKEV+16,PEEK(V+16)OR1:NX=NX-255
KX 830 POKEV,NX
BD 840 SYS51011
PP 850 IFPEEK(50978)<>0THEN840
GJ 860 POKE49189,0:POKEV+21,120:SYS49185:GOTO530
BK 870 FL=10:FORL=2TO10:IFX<(L-1)*32+24THEN890
QQ 880 NEXT:L=11
RP 890 L=L-1:NCOLR=BAR(L):POKE53280,BAR(L):CR=BAR(L):GOSUB1290:GOTO530
GD 900 CO(SB)=NCOLR:FL=9:POKE49189,0:POKEV+21,120
KR 910 POKE53280,14:CR=14:GOSUB1290
QD 920 POKEV+1,FP(2,SB):NX=FP(1,SB):IFNX<256THEN940
AQ 930 POKEV+16,PEEK(V+16)OR1:NX=NX-255
FR 940 POKEV,NX:POKE53285,CO(SB)
FM 950 POKEV+21,(PEEK(V+21)AND251)OR1
KF 960 POKE49189,0:SYS49185:RETURN
SR 970 FL=9:POKE53280,14:NCOLR=0:CR=14:GOSUB1290:GOTO760
QA 980 NM$="":II=0
BC 990 GETA$:IFA$=""THEN990
RC 1000 IFA$=CHR$(13)THENRETURN
MM 1010 IFA$=CHR$(20)THENPRINTCHR$(20);:II=II-1:NM$=LEFT$(NM$,II):GOTO990
DP 1020 IFA$<CHR$(48)ORA$>CHR$(90)THEN990
EQ 1030 II=II+1:NM$=NM$+A$:PRINTA$;:GOTO990
PD 1040 FP(1,0)=294:FP(1,1)=294:FP(1,2)=294:FP(1,3)=294:FP(1,4)=294:FP(1,5)=294
MQ 1050 FP(2,1)=110:FP(2,2)=140:FP(2,3)=165:FP(2,4)=190:FP(2,5)=218
PB 1060 FOR I=6TO9:FP(1,I)=65+(I-5)*45:FP(2,I)=220:NEXT:FP(1,7)=FP(1,7)-5
PA 1070 FP(1,8)=FP(1,8)-2
SP 1080 FORI=1TO5:MP(1,I)=255:MP(2,I)=FP(2,I):NEXT
AG 1090 FORI=6TO9:MP(1,I)=FP(1
```

```
     ,I):MP(2,I)=FP(2,I)-24
     :NEXT
QX 1100 MP(2,5)=FP(2,5)-24:RET
     URN
HK 1110 POKE251,Ø:POKE252,4:PO
     KE253,39:POKE254,4:POK
     E49152,32:SYS49153
KB 1120 CR=14:FL=9:POKE53280,C
     R:GOSUB1290
QF 1130 POKE51729,Ø:OPEN15,8,1
     5:SYS51419:IFY<75THEN1
     190
FE 1140 PRINT"{HOME}{BLU}LOAD
     {SPACE}FILE NAME :";:G
     OSUB980:SYS51669:GOSUB
     1290
GS 1150 OPEN2,8,2,NM$:INPUT#15
     ,A$,B$,C$:SYS51419
JP 1160 IFA$="ØØ"THENPRINT"
     {HOME}LOADING "NM$:FOR
     I=1TO1000:NEXT:SYS5166
     9:GOTO1180
PQ 1170 PRINT"{HOME}{2 SPACES}
     "B$:FORI=1TO3000:NEXT:
     GOTO1230
ES 1180 GOSUB1290:SYS51937:POK
     E14847,255:GOTO1250
FK 1190 PRINT"{HOME}{BLU}SAVE
     {SPACE}FILE NAME: ";:G
     OSUB980:SYS51669:NM$=N
     M$+",S,W":GOSUB1290
MA 1200 OPEN2,8,2,NM$:INPUT#15
     ,A$,B$,C$,C$:SYS51419
DA 1210 IFA$="ØØ"THENPRINT"
     {HOME} SAVING "NM$:GOT
     O1240
MQ 1220 PRINT"{HOME}{2 SPACES}
     "B$:FORI=1TO3000:NEXT
AH 1230 SYS51669:GOSUB1310:GOS
     UB1290:P1$="@":GOTO520
JA 1240 FORI=1TO2000:NEXTI:SYS
     51669:GOSUB1290:SYS517
     Ø8
FC 1250 GOSUB1310:P1$="@"
PR 1260 IFPEEK(51729)=ØTHEN520
RS 1270 SYS51419:PRINT"{HOME}
     {SPACE}BAD DISK ACCESS
     . CODE = "PEEK(51729)
DE 1280 FORI=1TO3000:NEXT:SYS5
     1669:GOSUB1290:GOTO520
CE 1290 POKE251,Ø:POKE252,216:
     POKE253,40:POKE254,216
     :POKE49152,CR:SYS49153
AA 1300 RETURN
FB 1310 SYS65484:CLOSE2:CLOSE1
     5:RETURN
MD 1320 POKE56,160:CLR:SYS 647
     59
HC 1330 END
```

Program 2: Color Craft—Machine Language Section

See instructions in article on page 62 before typing in.

```
CØØØ:ØØ D8 AØ ØØ AD ØØ CØ 91 4C
CØØ8:FB 18 A5 FB 69 Ø1 85 FB 58
CØ1Ø:A5 FC 69 ØØ 85 FC C5 FE 7B
CØ18:DØ EA A5 FB C5 FD DØ E4 DD
CØ2Ø:6Ø 4C 48 CØ C6 8E 43 C6 B7
CØ28:8C 44 C6 6Ø 2Ø 1D CØ BA 91
CØ3Ø:BD Ø1 Ø1 C9 8C DØ Ø7 BD Ø1
CØ38:Ø2 Ø1 C9 A4 FØ ØF AC 44 DF
CØ4Ø:C6 AE 43 C6 AD 42 C6 48 F1
CØ48:AD 25 DØ 29 ØF 8D 24 CØ 4E
CØ5Ø:C9 ØØ DØ Ø5 A9 Ø3 8D 24 B9
CØ58:CØ AØ ØØ 8C 2A CØ 8C 2E C6
CØ6Ø:CØ 8C 26 CØ 8C 29 CØ 8C 4D
CØ68:3A CØ 8C 3E CØ A9 Ø7 85 EC
CØ7Ø:FC A9 F8 18 6D 25 CØ 85 82
CØ78:FB B1 FB 38 E9 ØD ØA ØA Ø9
CØ8Ø:ØA ØA ØA ØA 18 69 4Ø 85 D7
CØ88:FB A9 Ø3 69 ØØ 85 FC AD 27
CØ9Ø:24 CØ C9 Ø3 DØ Ø4 A9 FF A7
CØ98:91 FB B1 FB C9 ØØ DØ Ø9 DØ
CØAØ:C8 98 C9 3F DØ E9 6Ø 91 5A
CØA8:FB A2 CØ 8E 27 CØ A2 ØØ 53
CØBØ:8E 2A CØ 2D 27 CØ C9 ØØ BE
CØB8:DØ 17 AD 27 CØ EE 2A CØ 67
CØCØ:EE 2A CØ 4A 4A C9 ØØ FØ 6B
CØC8:D7 8D 27 CØ B1 FB 4C B3 54
CØDØ:CØ C9 Ø4 9Ø Ø5 4A 4A 4C EØ
CØD8:D1 CØ 8D 28 CØ A2 DØ 86 6Ø
CØEØ:FE AD 25 CØ ØA 85 FD 8C EC
CØE8:26 CØ AØ ØØ B1 FD 8D 2B 8D
CØFØ:CØ AD 26 CØ 2Ø 6D C2 AD F8
CØF8:3Ø CØ ØA ØA ØA 18 6D 2A 5A
C1ØØ:CØ 18 6D 2B CØ 8D 2D CØ A1
C1Ø8:AD 2C CØ 69 ØØ 8D 2E CØ 6F
C11Ø:A2 1Ø 86 FD AØ ØØ B1 FD FF
C118:8D 29 CØ AD 25 CØ 18 69 65
C12Ø:Ø1 2D 29 CØ C9 ØØ FØ 11 E1
C128:18 AD 2D CØ 69 FF 8D 2D 68
C13Ø:CØ AD 2E CØ 69 ØØ 8D 2E E5
C138:CØ AD 2D CØ 38 E9 18 8D 6Ø
C14Ø:2D CØ AD 2E CØ E9 ØØ 8D 5E
C148:2E CØ AD 2D CØ 4A ØA 8D 6C
C15Ø:2D CØ AD 2D CØ 8D 2B CØ 76
C158:AD 2E CØ 8D 2C CØ 4E 2C 5C
C16Ø:CØ 6E 2B CØ 4E 2C CØ 6E 64
C168:2B CØ 4E 2C CØ 6E 2B CØ 15
C17Ø:18 AD 2B CØ 8D 2F CØ A2 2A
C178:DØ 86 FE AD 25 CØ ØA 18 19
C18Ø:69 Ø1 85 FD AØ ØØ B1 FD EF
C188:8D 31 CØ AD 26 CØ 2Ø 6D F3
C19Ø:C2 8A 18 6D 31 CØ 38 E9 D8
C198:32 8D 31 CØ 4A 4A 4A 8D 68
C1AØ:32 CØ AD 31 CØ 29 Ø7 8D 7C
C1A8:36 CØ AD 2D CØ 29 Ø7 8D 46
C1BØ:37 CØ 38 A9 Ø7 ED 37 CØ CØ
C1B8:8D 37 CØ A9 ØØ 85 FD 85 1B
C1CØ:FE AD 32 CØ C9 ØØ FØ 1D CE
C1C8:AA A9 Ø1 8D 39 CØ A9 4Ø 65
C1DØ:8D 38 CØ 18 AD 38 CØ 65 F7
C1D8:FD 85 FD AD 39 CØ 65 FE ED
C1EØ:85 FE CA DØ EE A2 Ø8 AD ØD
C1E8:2F CØ 18 65 FD 85 FD A5 35
C1FØ:FE 69 ØØ 85 FE CA DØ EF 5B
C1F8:18 AD 36 CØ 65 FD 85 FD F2
C2ØØ:A5 FE 69 ØØ 85 FE 8D 34 BC
C2Ø8:CØ A5 FD 8D 33 CØ 18 A9 66
C21Ø:2Ø 65 FE 85 FE AD 24 CØ EE
C218:C9 Ø3 DØ Ø8 A9 ØØ 8D 35 7B
C22Ø:CØ 4C 27 C2 2Ø 7F C2 AE 5D
C228:37 CØ A9 Ø3 CA FØ Ø4 ØA ØB
C23Ø:4C 2C C2 8D 3A CØ 38 A9 Ø7
C238:FF ED 3A CØ 8D 3E CØ AØ 14
C24Ø:ØØ B1 FD 2D 3E CØ 91 FD DA
C248:A6 Ø3 AD 35 CØ D8 ØA ØA 72
C25Ø:18 6D 35 CØ CA DØ F6 8D Ø5
C258:35 CØ 2D 3A CØ 8D 3A CØ 63
C26Ø:B1 FD ØD 3A CØ 91 FD AC 78
C268:26 CØ 4C BA CØ A2 ØØ 8D 84
C27Ø:3Ø CØ 38 E9 Ø3 9Ø Ø7 E8 35
C278:8D 3Ø CØ 4C 72 C2 6Ø A5 B2
C28Ø:FD 8D 3C CØ A5 FE 8D 3D 7D
C288:CØ 4E 34 CØ 6E 33 CØ 4E A4
C29Ø:34 CØ 6E 33 CØ 4E 34 CØ C9
C298:6E 33 CØ A9 Ø4 85 FE A9 B2
C2AØ:ØØ 85 FD 18 6D 33 CØ 85 Ø8
C2A8:FD A5 FE 6D 34 CØ 85 FE FB
C2BØ:AØ ØØ B1 FD 4A 4A 4A 4A F6
C2B8:C9 ØØ FØ 6E CD 24 CØ FØ 99
C2CØ:69 C9 Ø3 FØ 65 A9 Ø2 8D 4Ø
C2C8:35 CØ B1 FD 29 ØF C9 ØØ 48
C2DØ:FØ 4Ø C9 Ø3 FØ 3C CD 24 8Ø
C2D8:CØ FØ 37 A9 D8 85 FE A9 Ø1
C2EØ:ØØ 85 FD 18 6D 33 CØ 85 48
C2E8:FD A5 FE 6D 34 CØ 85 FE 3C
C2FØ:A9 Ø3 8D 35 CØ B1 FD 29 Ø3
C2F8:ØF C9 ØØ FØ 15 CD 24 CØ 7Ø
C3ØØ:FØ 1Ø C9 Ø3 FØ ØC 2Ø 4B BØ
C3Ø8:C3 AØ ØØ AD 35 CØ C9 Ø1 B5
C31Ø:FØ 18 AD 24 CØ 8D 3B CØ 81
C318:B1 FD 29 FØ ØD 3B CØ 91 94
C32Ø:FD AD 35 CØ 8D 28 CØ 4C 9F
C328:4Ø C3 AD 24 CØ ØA ØA ØA Ø5
C33Ø:ØA 8D 3B CØ A9 Ø1 8D 35 35
C338:CØ B1 FD 29 ØF 4C 1C C3 84
C34Ø:AD 3C CØ 85 FD AD 3D CØ FF
C348:85 FE 6Ø A5 FD 8D 46 CØ 2C
C35Ø:A5 FE 8D 47 CØ AD 33 CØ 74
C358:8D 42 CØ AD 34 CØ 8D 43 2D
C36Ø:CØ ØE 42 CØ 2E 43 CØ ØE 2E
C368:42 CØ 2E 43 CØ ØE 42 CØ BE
C37Ø:2E 43 CØ A9 2Ø 18 6D 43 12
C378:CØ 8D 43 CØ 85 FE AD 42 FD
C38Ø:CØ 85 FD AØ ØØ A2 Ø8 8C BA
C388:3F CØ 8C 4Ø CØ 8C 41 CØ FØ
C39Ø:A9 Ø4 8D 44 CØ B1 FD 8D 3A
C398:45 CØ 29 CØ C9 CØ DØ Ø6 1D
C3AØ:EE 4Ø CØ 4C B7 C3 C9 8Ø 6D
C3A8:DØ Ø6 EE 41 CØ 4C B7 C3 76
C3BØ:C9 4Ø DØ Ø3 EE 3F CØ ØE 7B
C3B8:45 CØ ØE 45 CØ AD 45 CØ 31
C3CØ:CE 44 CØ DØ D5 C8 CA DØ 1E
C3C8:C7 A9 Ø1 8D 35 CØ AD 3F DE
C3DØ:CØ CD 41 CØ 9Ø Ø8 A9 Ø2 5A
C3D8:8D 35 CØ AD 41 CØ CD 4Ø 5Ø
C3EØ:CØ 9Ø 1Ø A9 Ø3 8D 35 CØ Ø3
C3E8:AD 46 CØ 85 FD AD 47 CØ 3F
C3FØ:85 FE 6Ø 18 AD 34 CØ 69 B1
C3F8:Ø4 85 FE AD 33 CØ 85 FD 44
C4ØØ:6Ø ØØ ØØ ØØ ØØ ØØ ØØ 55 ØF
C4Ø8:55 54 55 55 54 55 55 54 48
C41Ø:55 55 54 55 55 54 55 55 75
C418:54 55 55 54 55 55 54 55 ØF
C42Ø:55 54 55 55 54 55 55 54 6Ø
C428:55 55 54 55 55 54 55 55 8D
C43Ø:54 55 55 54 55 55 54 55 27
C438:55 54 ØØ ØØ ØØ ØØ ØØ ØØ 81
C44Ø:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ C9
C448:ØØ ØØ ØØ 14 ØØ ØØ 55 ØØ BD
C45Ø:Ø1 55 4Ø Ø1 55 4Ø Ø5 55 D2
C458:5Ø Ø5 55 5Ø Ø5 55 5Ø Ø5 1E
C46Ø:55 5Ø Ø1 55 4Ø Ø1 55 4Ø ØF
C468:ØØ 55 ØØ ØØ 14 ØØ ØØ ØØ E7
C47Ø:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ F9
C478:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ Ø2
C48Ø:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØA
C488:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 12
C49Ø:Ø1 55 4Ø Ø1 55 4Ø Ø1 55 ØB
C498:4Ø Ø1 55 4Ø Ø1 55 4Ø Ø1 1Ø
C4AØ:55 4Ø Ø1 55 4Ø Ø1 55 4Ø 4B
C4A8:Ø1 55 4Ø ØØ ØØ ØØ ØØ ØØ 1Ø
C4BØ:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 3A
C4B8:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 42
C4CØ:ØØ FF FF FF CØ ØØ Ø3 CØ 17
C4C8:ØØ Ø3 CØ ØØ Ø3 CØ ØØ Ø3 49
C4DØ:CØ ØØ Ø3 CØ ØØ Ø3 CØ ØØ B4
C4D8:Ø3 CØ ØØ Ø3 CØ ØØ Ø3 CØ 11
C4EØ:ØØ Ø3 CØ ØØ Ø3 CØ ØØ Ø3 61
C4E8:CØ ØØ Ø3 CØ ØØ Ø3 CØ ØØ CC
C4FØ:Ø3 CØ ØØ Ø3 CØ ØØ Ø3 CØ 29
C4F8:ØØ Ø3 CØ ØØ Ø3 FF FF FF 73
C5ØØ:ØØ Ø1 55 4Ø Ø1 55 4Ø Ø1 59
C5Ø8:55 4Ø Ø1 55 4Ø Ø1 55 4Ø B4
C51Ø:Ø1 55 4Ø Ø1 55 4Ø Ø1 55 8C
C518:4Ø Ø1 55 4Ø Ø1 55 4Ø Ø1 91
C52Ø:55 4Ø Ø1 55 4Ø Ø1 55 4Ø CC
C528:Ø1 55 4Ø Ø1 55 4Ø Ø1 55 A4
C53Ø:4Ø Ø1 55 4Ø Ø1 55 4Ø Ø1 A9
C538:55 4Ø Ø1 55 4Ø Ø1 55 4Ø E4
C54Ø:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ CB
C548:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ D3
C55Ø:ØØ ØØ ØØ 55 55 55 55 55 31
C558:55 55 55 55 55 55 55 55 E3
C56Ø:55 55 55 55 55 55 55 55 EB
C568:55 55 55 55 55 55 ØØ ØØ F3
C57Ø:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ FB
C578:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ Ø4
C58Ø:ØØ 4Ø ØØ ØØ 5Ø ØØ ØØ 54 F2
C588:ØØ ØØ 55 ØØ ØØ 55 4Ø ØØ 94
C59Ø:55 5Ø ØØ 55 54 ØØ 55 55 D2
C598:ØØ 55 55 4Ø 55 55 5Ø 55 1E
C5AØ:55 54 55 55 5Ø 55 55 4Ø AE
C5A8:55 55 ØØ 55 54 ØØ 55 5Ø 27
C5BØ:ØØ 55 4Ø ØØ 55 ØØ ØØ 54 98
```

```
C5B8:00 00 50 00 00 40 00 00 4F
C5C0:00 00 00 01 00 00 05 00 66
C5C8:00 15 00 00 55 00 01 55 9B
C5D0:00 05 55 00 15 55 00 55 9B
C5D8:55 01 55 55 05 55 55 15 8C
C5E0:55 55 05 55 55 01 55 55 11
C5E8:00 55 55 00 15 55 00 05 77
C5F0:55 00 01 55 00 00 55 00 47
C5F8:00 15 00 00 05 00 00 01 F2
C600:00 92 49 24 00 00 01 80 20
C608:00 00 00 00 01 80 00 00 9F
C610:00 00 01 80 00 00 00 00 C5
C618:01 22 F2 08 32 82 08 2A 63
C620:E2 48 26 82 48 22 F1 B0 7D
C628:00 00 01 80 00 00 00 00 DD
C630:01 80 00 00 00 00 01 80 E0
C638:00 00 00 00 01 92 49 24 CE
C640:00 92 49 24 00 00 01 80 60
C648:00 00 00 00 01 80 00 00 DF
C650:00 00 01 80 00 00 00 00 06
C658:01 1E 44 E0 10 64 90 1C D3
C660:54 90 10 4C 90 1E 44 E0 69
C668:00 00 01 80 00 00 00 00 1E
C670:01 80 00 00 00 00 01 80 21
C678:00 00 00 00 01 92 49 24 0F
C680:00 00 00 00 00 15 00 00 62
C688:55 40 01 55 50 01 55 50 C7
C690:05 55 54 05 55 54 15 55 4C
C698:55 15 55 55 15 55 55 15 D3
C6A0:55 55 15 55 55 05 55 54 E3
C6A8:05 55 54 01 55 50 01 55 EB
C6B0:50 00 55 40 00 15 00 00 69
C6B8:00 00 00 00 00 00 00 00 46
C6C0:00 00 00 00 00 00 00 00 4E
C6C8:00 00 00 00 00 00 00 00 56
C6D0:00 00 00 00 00 00 0C 00 76
C6D8:00 03 00 C0 00 FF F0 03 18
C6E0:00 C0 0C 00 00 00 00 00 20
C6E8:00 00 00 00 00 00 00 00 76
C6F0:00 00 00 00 00 00 00 00 7E
C6F8:00 00 00 00 00 00 00 00 86
C700:A0 00 AE FA CF AD FB CF 62
C708:85 FB AD FC CF 85 FC AD 1B
C710:FD CF 85 FD AD FE CF 85 B1
C718:FE B1 FB 91 FD C8 CA D0 A5
C720:F8 60 FF 00 AD 00 DC 8D F8
C728:23 C7 29 10 8D 22 C7 AD 93
C730:23 C7 29 0F 8D 23 C7 A9 8B
C738:0F 38 ED 23 C7 8D 23 C7 CF
C740:60 00 FF AD 25 C0 0A 8D A8
C748:42 C7 C9 00 D0 03 EE 42 D6
C750:C7 20 24 C7 20 A0 C8 AD 8F
C758:22 C7 C9 00 D0 01 60 AE 1E
C760:23 C7 E0 00 F0 DD E0 01 51
C768:D0 0C A0 01 B1 FB 38 E9 5F
C770:01 91 FB 4C 70 C8 E0 02 93
C778:D0 0C A0 01 B1 FB 18 69 AE
C780:01 91 FB 4C 70 C8 E0 07 A8
C788:B0 70 AD 10 D0 2D 42 C7 CA
C790:F0 14 A0 00 B1 FB C9 00 C2
C798:D0 0C A9 FF 38 ED 42 C7 8E
C7A0:2D 10 D0 8D 10 D0 E0 04 47
C7A8:D0 12 A0 00 B1 FB 8D 41 13
C7B0:C7 CE 41 C7 AD 41 C7 91 10
C7B8:FB 4C 70 C8 E0 05 D0 1B CB
C7C0:A0 00 B1 FB 8D 41 C7 CE 66
C7C8:41 C7 AD 41 C7 91 FB A0 D1
C7D0:01 B1 FB 38 E9 01 91 FB C2
C7D8:4C 70 C8 E0 06 D0 1B A0 1C
C7E0:01 B1 FB 18 69 01 91 FB CC
C7E8:A0 00 B1 FB 8D 41 C7 CE 8E
C7F0:41 C7 AD 41 C7 91 FB 4C A5
C7F8:70 C8 AD 10 D0 2D 42 C7 31
C800:F0 10 A0 00 B1 FB C9 3D 70
C808:D0 19 38 E9 01 91 FB 4C 80
C810:23 C8 A0 00 B1 FB C9 FF 8A
C818:D0 09 AD 10 D0 0D 42 C7 12
C820:8D 10 D0 E0 08 D0 12 A0 EC
C828:00 B1 FB 8D 41 C7 EE 41 C6
C830:C7 AD 41 C7 91 FB 4C 70 3B
C838:C8 E0 09 D0 1B A0 00 B1 A1
C840:FB 8D 41 C7 EE 41 C7 AD 91
C848:41 C7 91 FB A0 01 B1 FB C6
C850:38 E9 01 91 FB 4C 70 C8 6C
C858:A0 00 B1 FB 8D 41 C7 EE 20
C860:41 C7 AD 41 C7 91 FB A0 6B
C868:01 B1 FB 18 69 01 91 FB 56
C870:A0 00 B1 FB C9 1B B0 0F 73
C878:AD 10 D0 2D 42 C7 D0 07 AB
C880:B1 FB 18 69 01 91 FB A0 6A
C888:01 B1 FB C9 3A B0 06 18 DB
C890:69 01 91 FB 60 C9 EF B0 C3
C898:01 60 38 E9 01 91 FB 60 0F
C8A0:20 E4 FF C9 00 D0 01 60 BD
C8A8:C9 11 D0 06 A9 01 8D 23 6D
C8B0:C7 60 C9 91 D0 06 A9 02 84
C8B8:8D 23 C7 60 C9 9D D0 06 45
C8C0:A9 04 8D 23 C7 60 C9 1D 7C
C8C8:D0 06 A9 08 8D 23 C7 60 E2
C8D0:C9 20 F0 01 60 A9 00 8D B4
C8D8:22 C7 60 78 A9 7F 8D 0D 74
C8E0:DC A9 01 8D 1A D0 A9 02 AD
C8E8:85 FD AD 4B C9 8D 12 D0 A0
C8F0:A9 3B 8D 11 D0 AD 14 03 51
C8F8:8D 49 C9 AD 15 03 8D 4A D1
C900:C9 A9 0D 8D 14 03 A9 C9 27
C908:8D 15 03 58 60 AD 19 D0 4A
C910:8D 19 D0 29 01 F0 2B C6 46
C918:FD 10 04 A9 01 85 FD A6 8A
C920:FD BD 51 C9 8D 18 D0 BD 15
C928:4D C9 8D 11 D0 BD 4F C9 7D
C930:8D 16 D0 BD 53 C9 8D 21 04
C938:D0 BD 4B C9 8D 12 D0 8A 8A
C940:F0 06 68 A8 68 AA 68 40 64
C948:4C 40 C9 31 39 3B 1B 18 63
C950:08 18 14 03 0E CC CC 00 DD
C958:00 01 00 80 00 00 81 C1 F8
C960:00 02 21 00 82 20 00 82 AF
C968:01 00 01 01 00 80 80 00 AF
C970:80 41 00 00 21 00 82 20 C2
C978:00 82 21 00 01 C1 00 80 60
C980:00 00 80 01 00 66 66 00 9A
C988:00 00 00 00 00 00 00 00 1C
C990:00 00 00 00 00 CC CC 00 F0
C998:00 01 00 80 01 00 82 00 81
C9A0:00 02 01 00 82 01 00 82 6F
C9A8:00 00 02 01 00 82 01 00 98
C9B0:82 00 00 02 01 00 82 21 D3
C9B8:00 82 20 00 03 E1 00 80 11
C9C0:01 00 80 00 00 66 66 00 4B
C9C8:00 00 00 00 00 00 00 00 5C
C9D0:00 00 00 00 00 AD 12 D0 10
C9D8:C9 3B 90 F9 78 A9 00 8D C9
C9E0:1A D0 A9 FF 8D 0D DC AD F2
C9E8:49 C9 8D 14 03 AD 4A C9 B3
C9F0:8D 15 03 58 60 4C 18 CA A5
C9F8:00 16 40 30 D8 A9 00 8D 18
CA00:F5 C9 A2 02 20 C9 FF 90 30
CA08:03 4C C9 CB 20 B7 FF F0 F8
CA10:03 4C C9 CB A9 14 8D F6 DF
CA18:C9 A9 28 85 FB A9 04 85 6E
CA20:FC 20 A3 CA A9 14 8D F6 0D
CA28:C9 A9 28 85 FB A9 D8 85 28
CA30:FC 20 A3 CA A9 14 8D F6 1D
CA38:C9 A9 40 85 FB A9 21 85 CB
CA40:FC A0 00 B1 FB 8D FB C9 6F
CA48:20 D2 FF 20 B7 FF F0 03 47
CA50:4C C9 CB AD FB C9 F0 0E C9
CA58:C8 D0 E8 20 D3 CA CE F6 04
CA60:C9 D0 E0 4C CC CB B1 FB E4
CA68:D0 0E C8 D0 F9 20 D3 CA D2
CA70:CE F6 C9 D0 F1 4C CC CB 97
CA78:8D FB C9 98 18 65 FB 8D 72
CA80:F9 C9 A5 FC 69 00 8D FA 6B
CA88:C9 AD F9 C9 20 D2 FF AD 44
CA90:FA C9 20 D2 FF AD FB C9 BF
CA98:20 D2 FF 20 B7 FF F0 B8 4D
CAA0:4C C9 CB A0 1F B1 FB 20 2A
CAA8:D2 FF 90 03 4C C9 CB 20 2B
CAB0:B7 FF F0 03 4C C9 CB 88 1A
CAB8:10 EB CE F6 C9 AD F6 C9 57
CAC0:D0 01 60 18 A5 FB 69 28 A4
CAC8:85 FB A5 FC 69 00 85 FC F7
CAD0:4C A3 CA 18 A5 FB 69 40 80
CAD8:85 FB A5 FC 69 01 85 FC 0C
CAE0:60 D8 A9 00 8D F5 C9 A2 8C
CAE8:02 20 C6 FF 90 03 4C C9 53
CAF0:CB 20 B7 FF F0 03 4C C9 61
CAF8:CB A9 14 8D F6 C9 A9 28 94
CB00:85 FB A9 04 85 FC 20 8E BD
CB08:CB A9 14 8D F6 C9 A9 28 A5
CB10:85 FB A9 D8 85 FC 20 8E 1B
CB18:CB A9 14 8D F6 C9 A9 40 CD
CB20:85 FB A9 21 85 FC A0 00 22
CB28:20 CF FF 8D FB C9 20 B7 9B
CB30:FF F0 0A C9 40 D0 03 4C 79
CB38:BC CB 4C C9 CB AD FB C9 1E
CB40:91 FB F0 0E C8 D0 E1 20 0C
CB48:D3 CA CE F6 C9 D0 D9 4C 57
CB50:CC CB 20 CF FF 8D F7 C9 32
CB58:20 CF FF 8D F8 C9 18 98 84
CB60:65 FB 8D F9 C9 A5 FC 69 43
CB68:00 8D FA C9 AD F7 C9 CD 0E
CB70:F9 C9 D0 08 AD F8 C9 CD C4
CB78:FA C9 F0 AC A9 00 91 FB 55
CB80:C8 D0 DB 20 D3 CA CE F6 8C
CB88:C9 D0 D3 4C CC CB A0 1F 6E
CB90:20 CF FF 8D FB C9 20 B7 04
CB98:FF F0 03 4C C9 CB AD FB 66
CBA0:C9 91 FB 88 10 EA CE F6 4A
CBA8:C9 D0 01 60 18 A5 FB 69 38
CBB0:28 85 FB A5 FC 69 00 85 AA
CBB8:FC 4C 8E CB A9 3F 8D F7 CD
CBC0:C9 A9 40 8D F8 C9 4C 5E 6E
CBC8:CB 8D F5 C9 60 00 00 00 08
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Power BASIC: 128 Partitioner

Article on page 90.

```
MJ 10 BANK0:FORD=6555TO6655
SX 20 READY$:Y=DEC(Y$):POKED,Y
      :X=X+Y:NEXT
FG 30 IFX<>11224THENPRINT"ERRO
      R IN DATA STATEMENTS.":S
      TOP
DK 40 FORD=0TO2:POKE23552+D,0
QE 50 POKE39936+D,0:POKE56320+
      D,0:NEXT
AA 60 PRINT"{CLR}SYS6555,(1-4)
       FOR PARTITION
PM 70 PRINT"{DOWN}PRINT PEEK(6
      655) FOR CURRENT PARTITI
      ON{2 SPACES}NUMBER"
GC 80 POKE4627,92:BANK15:NEW
EX 90 DATA EA,EA,EA,AA,CA,E0,0
      4,90,03,4C
CB 100 DATA 28,7D,AD,FE,19,8E,
       FE,19,0A,A8
QX 110 DATA AD,10,12,99,F0,19,
       AD,11,12,99
DB 120 DATA F1,19,BD,EB,19,85,
       2E,BD,EC,19
QD 130 DATA 8D,13,12,8A,A8,E8,
       8E,FF,19,0A
JS 140 DATA AA,BD,F0,19,8D,10,
       12,BD,F1,19
GK 150 DATA 8D,11,12,B9,F8,19,
       F0,0B,A9,FC
FH 160 DATA A2,19,85,3D,86,3E,
       4C,DC,4D,60
GQ 170 DATA 1C,5C,9C,DC,FF,03,
       1C,03,5C,03
GX 180 DATA 9C,03,DC,0,0,0,1,8
       A,00,00,01
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Text Sequencer

Article on page 79.

Program 1: Text Sequencer

```
FD 10 PRINT"{CLR}CREATING ML F
      ILE...":FORX=ØTO167:READ
      A:POKE828+X,A:CK=CK+A:NE
      XT
GA 20 IFCK<>19807THENPRINT"ERR
      OR IN DATA STATEMENTS.":
      STOP
AA 30 OPEN1,8,1,"Ø:TEXT SEQ.OB
      J"
JR 40 POKE780,253:POKE253,6Ø:P
      OKE254,3:POKE781,227:POK
      E782,3:SYS65496:CLOSE1
QS 5Ø DATA 162,2,32,198,255,32
      ,2Ø7,255,2Ø1,47
XA 6Ø DATA 24Ø,46,166,144,224,
      64,24Ø,89,2Ø1,37
SJ 7Ø DATA 24Ø,21,2Ø1,6Ø,24Ø,2
      2,2Ø1,62,24Ø,23
PP 8Ø DATA32,21Ø,255,166,197,2
      34,224,3,24Ø,18
HR 9Ø DATA 76,65,3,169,5,76,9Ø
      ,3,169,3Ø
AH 1ØØ DATA 76,9Ø,3,169,159,76
       ,9Ø,3,32,127
EQ 11Ø DATA 3,32,176,3,76,65,3
       ,16Ø,Ø,185
BK 12Ø DATA 182,3,24Ø,7,32,21Ø
       ,255,2ØØ,76,129
MJ 13Ø DATA 3,165,197,234,141,
       228,3,2Ø1,6Ø,24Ø
MG 14Ø DATA 25,173,228,3,2Ø1,1
       ,24Ø,3,76,141
EH 15Ø DATA 3,32,167,3,1Ø4,1Ø4
       ,96,169,2,32
SE 16Ø DATA 195,255,32,2Ø4,255
       ,96,169,147,32,21Ø
QE 17Ø DATA 255,96,13,5,32,211
       ,2Ø8,193,195,197
FH 18Ø DATA 32,194,193,21Ø,154
       ,32,212,79,32,195
FX 19Ø DATA 79,78,84,73,78,85,
       69,44,5,32
KK 2ØØ DATA 21Ø,197,212,213,21
       Ø,2Ø6,154,32,7Ø,79
PP 21Ø DATA 82,32,2Ø5,69,78,85
       ,159,Ø
```

Program 2: Text Sequencer Demo

```
GM 5 POKE53281,Ø:REM COLOR Ø,1
      ON THE +4/16 FOR BLACK S
     CREEN
HF 1Ø PRINTCHR$(14):RE?M LOWER
      {SPACE}CASE
RR 2Ø IFA=ØTHENA=1:LOAD"TEXT S
      EQ.OBJ",8,1
FJ 3Ø PRINT"{CLR}{CYN}","THE T
      EXT SEQUENCER"
KF 4Ø PRINT,"{2 DOWN}CHOOSE AN
       OPTION:"
CM 5Ø PRINT"{DOWN}1 YOUR FILEN
      AME 1."
QE 6Ø PRINT"{DOWN}2 YOUR FILEN
      AME 2."
AB 7Ø GETA$:IFA$=""GOTO7Ø
PB 8Ø IF A$="1"THEN PRINT"
      {CLR}":OPEN2,8,2,"Ø:FILE
      NAME 1,S,R":SYS828:GOSUB
      1ØØ:GOTO3Ø
KF 9Ø IF A$="2"THEN PRINT"
      {CLR}":OPEN2,8,2,"Ø:FILE
      NAME 2,S,R":SYS828:GOSUB
      1ØØ:GOTO3Ø
QA 1ØØ CLOSE2:IFA$=CHR$(13) TH
       EN RETURN
JD 11Ø PRINT,"{DOWN}PRESS RETU
       RN FOR MENU"
JQ 12Ø GETA$:IFA$=CHR$(13)THEN
        RETURN
GK 13Ø GOTO12Ø
```

RAM Plus

See instructions in article on page 85 before typing in.

```
947Ø:A5 38 C9 BØ DØ Ø1 6Ø AD B7
9478:86 Ø2 AE 2Ø DØ AC 21 DØ 89
948Ø:8D CF 96 8E DØ 96 8C D1 EB
9488:96 A9 ØC A2 ØØ 85 FB 8D AE
949Ø:86 Ø2 8E 2Ø DØ 8E 21 DØ 25
9498:A9 73 AØ E4 2Ø 1E AB A2 49
94AØ:ØØ BD B4 96 FØ Ø6 2Ø D2 EB
94A8:FF E8 DØ F5 2Ø A9 96 C6 21
94BØ:FB 1Ø F9 BD D2 96 C9 8Ø FB
94B8:FØ Ø6 9D A7 Ø2 E8 DØ F3 53
94CØ:A9 AØ A2 ØØ AØ EØ 86 FB CC
94C8:86 FD 85 FC 84 FE A1 FB 94
94DØ:81 FB A1 FD 81 FD E6 FB 9B
94D8:E6 FD DØ F2 E6 FC E6 FE 36
94EØ:DØ EC 2Ø 53 E4 A9 48 A2 E7
94E8:EB 8D 8F Ø2 8E 9Ø Ø2 A9 E1
94FØ:A7 A2 Ø2 8D 16 Ø3 8D 18 9F
94F8:Ø3 8E 17 Ø3 8E 19 Ø3 A9 E2
95ØØ:A5 A2 F4 8D 3Ø Ø3 8E 31 F9
95Ø8:Ø3 A9 Ø3 A2 ØØ A8 85 FC 54
951Ø:86 FB 2Ø 99 96 CØ ØC 9Ø 7B
9518:F9 A9 C2 8D 12 Ø3 A9 AØ 6C
952Ø:85 FC AØ ØD 2Ø 99 96 CØ 87
9528:8Ø 9Ø F9 AØ 82 2Ø 99 96 5F
953Ø:C8 CØ 9E 9Ø F8 A9 A3 85 Ø8
9538:FC AØ 29 2Ø 99 96 CØ 64 3E
954Ø:9Ø F9 A9 89 85 FB A2 ØØ 61
9548:A1 FB C9 2Ø FØ Ø4 C9 4C F5
955Ø:DØ 15 AØ Ø2 B1 FB C9 AØ ØF
9558:9Ø ØD C9 CØ BØ Ø9 2Ø 93 D1
956Ø:96 2Ø 6D 95 2Ø 6D 95 2Ø E7
9568:6D 95 4C 46 95 E6 FB DØ AE
957Ø:ØE E6 FC FØ ØB A5 FC C9 BD
9578:DØ DØ Ø4 A9 EØ 85 FC 6Ø D2
958Ø:68 68 AØ BØ 86 33 84 34 57
9588:86 37 84 38 8E 83 Ø2 8C EB
959Ø:84 Ø2 A9 35 A2 2F 78 85 4F
9598:Ø1 86 ØØ 58 A9 FF A2 BF BD
95AØ:AØ CF 85 FB 85 FD 86 FC AE
95A8:84 FE A2 ØØ A1 FB 81 FD 28
95BØ:C6 FB C6 FD A5 FD C9 FF AF
95B8:DØ F2 A5 FE C9 BØ FØ Ø6 A6
95CØ:C6 FC C6 FE DØ E6 8D BE 53
95C8:B5 8D FC B5 8D Ø1 B6 8D 98
95DØ:32 B7 8D 3A B7 8D FB B7 FB
95D8:8D FF B7 8D F3 BD 8D 1B 67
95EØ:BE 8D 22 BE 8D 26 BE 8D ØF
95E8:37 BE 8D Ø1 FD 8D 71 FE 29
95FØ:A9 A4 8D ØF ED A9 A9 8D B3
95F8:42 BB A9 C1 8D C8 C1 A9 42
96ØØ:AF 8D D8 BF 8D DD BF A9 8C
96Ø8:B3 8D 3F B4 8D 44 B4 8D 1A
961Ø:68 B4 8D 77 B4 8D 4E B8 F8
9618:8D C5 CD 8D 9Ø E1 8D AE E5
962Ø:E1 AØ B7 8C 83 B7 AØ BC 1F
9628:8C F7 BC C8 8C 6E BB C8 1C
963Ø:8C A1 BE AØ C9 8C 8E B7 43
9638:8C ØØ CA 8C Ø7 CA 8C ØE 58
964Ø:CA 8C 15 CA 8C 1C CA 8C 3C
9648:27 CA 8C 2Ø E3 C8 8C Ø4 AE
965Ø:CB A9 CD 8D Ø3 CE 8D ØE DC
9658:CE 8D 19 CE A9 CF 8D 26 2E
966Ø:C1 8D 4C C8 8D 77 CF 8D 5F
9668:FØ CF 8D 36 EØ 8D 6F CE Ø2
967Ø:8D 76 CE 8D 7D CE 8D 84 7B
9678:CE A9 4C 8D 41 E4 AD CF A2
968Ø:96 8D 86 Ø2 AE DØ 96 8E C1
9688:2Ø DØ AC D1 96 8C 21 DØ A6
969Ø:4C 29 E4 18 69 1Ø 91 FB F6
9698:6Ø B1 FB C9 AØ 9Ø Ø7 C9 9D
96AØ:CØ BØ Ø3 2Ø 93 96 C8 C8 ØE
96A8:6Ø A2 ØØ AØ ØØ E8 DØ FD FB
96BØ:C8 DØ FA 6Ø 9D 12 41 44 D7
96B8:44 49 4E 47 2Ø 52 41 4D B2
96CØ:2E 2E 5Ø 4C 45 41 53 45 7A
96C8:2Ø 57 41 49 54 92 ØØ Ø1 86
96DØ:Ø2 Ø3 A9 73 AØ E4 2Ø 1E 23
96D8:BB A2 ØØ BD E6 Ø2 FØ Ø6 8F
96EØ:2Ø D2 FF E8 DØ F5 86 CC 99
96E8:A5 CB A2 ØØ 86 C6 C9 19 2C
96FØ:FØ Ø9 C9 27 DØ F2 86 CF B3
96F8:6C Ø2 BØ AØ AØ 86 33 84 Ø7
97ØØ:34 86 37 84 38 8E 83 Ø2 1F
97Ø8:8C 84 Ø2 2Ø 53 E4 4C 66 ØE
971Ø:FE 12 2Ø 45 58 49 54 2Ø 4C
9718:52 41 4D 2Ø 5Ø 4C 55 53 1E
972Ø:3F 2Ø 28 59 2F 4E 29 2Ø B6
9728:ØD ØØ 8Ø ØØ ØØ ØØ ØØ ØØ ED
```

Custom Keys

See instructions in article on page 88 before typing in.

Program 1: Custom Keys Creator

```
CØØØ:4C AC CØ ØD 54 48 45 2Ø 2A
CØØ8:4B 45 59 2Ø 4D 41 52 4B ØD
CØ1Ø:45 44 2Ø 2D 3F 2D 9D 9D A3
CØ18:12 ØØ 92 1D 1D 53 48 4F DC
CØ2Ø:55 4C 44 2Ø 52 45 5Ø 52 84
CØ28:45 53 45 4E 54 2Ø 54 48 C2
CØ3Ø:45 2Ø 2Ø 2Ø 43 48 41 52 72
CØ38:41 43 54 45 52 3A 2Ø 2D F2
CØ4Ø:3F 2D 9D 9D 12 ØØ 4F 4B B4
CØ48:2E 2Ø 28 5Ø 52 45 53 53 94
CØ5Ø:2Ø 12 43 54 52 4C 92 2Ø 1D
CØ58:2B 2Ø 41 4E 59 2Ø 4B 45 AB
CØ6Ø:59 2Ø 54 4F 2Ø 51 55 49 5Ø
CØ68:54 2E 29 ØD ØØ ØØ ØØ ØØ 95
CØ7Ø:ØD 46 49 4C 45 4E 41 4D 2B
CØ78:45 2Ø 28 3C 3D 31 36 2Ø A8
CØ8Ø:43 48 41 52 53 29 3A ØØ B6
CØ88:3Ø 3A 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 98
CØ9Ø:2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 2Ø 12
CØ98:2Ø 2Ø ØD 53 41 56 45 2Ø 17
CØAØ:53 45 54 3F 2Ø 28 59 2F 1F
CØA8:4E 29 2Ø ØØ 2Ø 54 C1 AØ 16
CØBØ:CØ A9 Ø3 2Ø 1E AB 2Ø 48 87
CØB8:C1 A6 C5 AC 77 Ø2 AD 8D F4
CØCØ:Ø2 8E 6D CØ 8C 6E CØ 8D CD
CØC8:6F CØ C9 Ø4 FØ 5B AD 6E 6A
CØDØ:CØ 2Ø D2 FF AØ CØ A9 1A 8A
CØD8:2Ø 1E AB 2Ø 48 C1 AD 77 85
CØEØ:Ø2 8D 6E CØ 2Ø D2 FF AD 9A
CØE8:6F CØ 29 Ø1 C9 Ø1 DØ ØC 87
CØFØ:AD 6D CØ 18 69 41 8D 6D 17
CØF8:CØ 4C ØE C1 AD 6F CØ 29 A1
C1ØØ:Ø2 C9 Ø2 DØ Ø9 AD 6D CØ DE
C1Ø8:18 69 82 8D 6D CØ AD 6E 53
C11Ø:CØ AE 6D CØ 9D 81 EB A9 CD
C118:ØD 2Ø D2 FF 2Ø D2 FF A9 7A
C12Ø:46 AØ CØ 2Ø 1E AB 4C AF FØ
C128:CØ A9 35 78 85 Ø1 58 AØ 26
C13Ø:CØ A9 9A 2Ø 1E AB 2Ø 48 FB
C138:C1 A2 ØØ 86 C6 AD 77 Ø2 8B
C14Ø:2Ø D2 FF C9 59 FØ 55 6Ø BE
C148:A9 ØØ 85 C6 A5 C6 18 C9 FF
C15Ø:Ø1 9Ø F9 6Ø A9 AØ 85 FC 95
```

```
C158:A9 00 85 FB 85 FD A9 C0 59
C160:85 FE 20 7D C1 A9 E0 85 3E
C168:FC A9 00 85 FB A9 FF 85 39
C170:FD 85 FE 20 7D C1 AD FF 84
C178:FF 8D FF FF 60 A0 00 B1 96
C180:FB 91 FB E6 FB A5 FB C9 8C
C188:00 D0 F2 E6 FC A5 FC F0 76
C190:0A C5 FE D0 E8 A5 FB C5 13
C198:FD D0 E2 60 A9 70 A0 C0 C2
C1A0:20 1E AB A2 00 8E 6D C0 31
C1A8:AD 6D C0 C9 10 F0 13 20 9D
C1B0:CF FF AE 6D C0 9D 8A C0 1B
C1B8:EE 6D C0 C9 0D D0 E9 CE 12
C1C0:6D C0 A9 01 A2 08 A0 01 E7
C1C8:20 BA FF AD 6D C0 18 69 ED
C1D0:02 A0 C0 A2 88 20 BD FF FF
C1D8:A9 81 A2 EB 85 FB 86 FC CA
C1E0:A2 44 A0 EC A9 FB 20 D8 FF
C1E8:FF 60 00 00 00 00 00 00 84
```

Program 2: Custom Keys Loader

```
CF05:46 49 4C 45 4E 41 4D 45 4F
CF0D:20 28 3C 3D 31 36 20 43 08
CF15:48 41 52 53 29 3A 00 0D E7
CF1D:45 52 52 4F 52 00 30 3A 60
CF25:41 52 52 4F 57 53 0D 53 AE
CF2D:45 0D 0D 20 20 20 20 20 38
CF35:20 06 20 9A CF A0 CF A9 5E
CF3D:05 20 1E AB A2 00 8E 36 4E
CF45:CF AD 36 CF C9 10 F0 13 7F
CF4D:20 CF FF AE 36 CF 9D 25 2D
CF55:CF EE 36 CF C9 0D D0 E9 6A
CF5D:CE 36 CF A9 01 A2 08 A0 C9
CF65:01 20 BA FF AD 36 CF 18 E2
CF6D:69 02 A2 23 A0 CF 20 BD 0B
CF75:FF 18 A9 00 A2 81 A0 EB 98
CF7D:20 D5 FF B0 10 20 B7 FF 1E
CF85:29 80 C9 80 F0 07 A9 35 47
CF8D:78 85 01 58 60 A0 CF A9 3F
CF95:1A 20 1E AB 60 A9 A0 85 39
CF9D:FC A9 00 85 FB 85 FD A9 1A
CFA5:C0 85 FE 20 C3 CF A9 E0 7A
CFAD:85 FC A9 00 85 FB A9 FF F3
CFB5:85 FD 85 FE 20 C3 CF AD 95
CFBD:FF FF 8D FF FF 60 A0 00 D1
CFC5:B1 FB 91 FB E6 FB A5 FB 9D
CFCD:D0 F4 E6 FC A5 FC F0 0A CC
CFD5:C5 FE D0 EA A5 FB C5 FD 87
CFDD:D0 E4 60 00 00 00 00 00 2B
```

Tile Trader

Article on page 58.

```
JC 10 VOL10:COLOR4,1:COLOR0,1:
      GOSUB970
DM 20 GOSUB640:FAST:CLR
QJ 30 GRAPHIC0,1
MF 40 Z$(1)="24":Z$(2)="135":Z
      $(3)="26":Z$(4)="157":Z$
      (5)="2468":Z$(6)="359"
CD 50 Z$(7)="48":Z$(8)="579":Z
      $(9)="68"
KH 60 DX(1)=90:DX(2)=115:DX(3)
      =140:DX(4)=90:DX(5)=115:
      DX(6)=140:DX(7)=90:DX(8)
      =115
CX 70 DX(9)=140
AD 80 DY(1)=70:DY(2)=70:DY(3)=
      70:DY(4)=92:DY(5)=92:DY(
      6)=92:DY(7)=114:DY(8)=11
      4
KC 90 DY(9)=114
BB 100 B=9
DR 110 FORI=1TO8:S(I)=I:NEXT
FK 120 FORI=1TO8:MOVSPRI,DX(I)
       ,DY(I):NEXT
EG 130 FORI=1TO8:SPRITEI,1,2,0
       ,0,0:NEXT
CQ 140 GOTO620
QQ 150 SLOW
KQ 160 PRINT"{CLR}{3 DOWN}
       {21 RIGHT}7{3 SPACES}8
       {3 SPACES}9"
BA 170 PRINT"{HOME}{6 DOWN}
       {21 RIGHT}4{3 SPACES}5
       {3 SPACES}6"
GS 180 PRINT"{HOME}{9 DOWN}
       {21 RIGHT}1{3 SPACES}2
       {3 SPACES}3"
EH 190 PRINT"{HOME}{18 DOWN}"
MK 200 PRINT"FROM ";
DB 210 GETKEYF$
MJ 220 IFF$<"0"ORF$>"9"THEN210
GD 230 A$=F$
FA 240 IFF$="9"THENF$="3":GOTO
       300
MM 250 IFF$="3"THENF$="9"
RB 260 IFF$="1"THENF$="7":GOTO
       300
MA 270 IFF$="7"THENF$="1"
PQ 280 IFF$="2"THENF$="8":GOTO
       300
QF 290 IFF$="8"THENF$="2"
JX 300 PP=0:FORI=1TOLEN(Z$(B))
       :IFVAL(MID$(Z$(B),I,1))
       =VAL(F$)THENPP=1:I=LEN(
       Z$(B))
GK 310 NEXT:IFPP=0THEN170
MK 320 MO=MO+1
MJ 330 T=B:F=VAL(F$)
MK 340 FORI=1TO8:IFS(I)=FTHENW
       =I:I=8
BH 350 NEXT
JD 360 PRINTA$:SPRITEW,0:MOVSP
       RW,DX(T),DY(T):SPRITEW,
       1,2:S(W)=T:B=F
HG 370 GOSUB510
FC 380 PP=0:FORI=1TO8:IFS(I)<>
       ITHENI=8:PP=1
ER 390 NEXT:IFPPTHEN190
PH 400 PRINT"YOU DID IT!":SOUN
       D1,25200,110,2,10600,95
       0,0:PRINT"IT TOOK YOU"M
       O"MOVE";:IFMO>1THENPRIN
       T"S";
CF 410 PRINT".":GOTO990
PX 420 SSHAPEA$(1),20,00,43,21
FJ 430 SSHAPEA$(2),44,00,67,21
AP 440 SSHAPEA$(3),68,00,91,21
KQ 450 SSHAPEA$(4),20,21,43,42
PR 460 SSHAPEA$(5),44,21,67,42
AJ 470 SSHAPEA$(6),68,21,91,42
HB 480 SSHAPEA$(7),20,42,43,63
RC 490 SSHAPEA$(8),44,42,67,63
EH 500 FORI=1TO8:SPRSAVA$(I),I
       :NEXT:RETURN
GJ 510 SOUND1,4500,11:RETURN
AD 520 SOUND1,4500,1:RETURN
HR 530 FORXX=1TOYY:PRINT"{CLR}
       "
EJ 540 PRINT"{20 DOWN}"
CS 550 F=INT(RND(0)*LEN(Z$(B))
       )+1
GK 560 F$=MID$(Z$(B),F,1):F=VA
       L(F$)
PP 570 FORI=1TO8:IFS(I)=FANDI<
       >WTHENW=I:GOTO590
FF 580 NEXT:GOTO540
EH 590 SPRITEW,0:MOVSPRW,DX(B)
       ,DY(B):SPRITEW,1,2:S(W)
       =B:B=F
KE 600 GOSUB520
CG 610 NEXTXX:GOTO150
ES 620 YY=0:SLOW:INPUT"{CLR}
       {12 DOWN}HOW MANY MOVES
        TO BE MIXED UP";YY:IFY
       Y=0THEN620
XK 630 PRINT"{PUR}{4 RIGHT}
       {DOWN}STUDY THE PICTURE
       ":SLEEP5:FAST:GOTO530
XM 640 PRINT"{2 DOWN}"TAB(12)"
       WHICH PUZZLE?"
CR 650 PRINT:PRINTTAB(12)"1. B
       ULLSEYE
AS 660 PRINTTAB(12)"2. HAPPY F
       ACE"
EB 670 PRINTTAB(12)"3. "CHR$(3
       4)"E"CHR$(34)
AQ 680 PRINTTAB(12)"4. 3-D BOX
       ES"
MQ 690 GETKEYA$:IFA$<"1"ORA$>"
       4"THEN690
JB 700 FAST:ONVAL(A$)GOSUB720,
       750,790,850
GX 710 GOTO420
CQ 720 GRAPHIC2,1:CIRCLE1,55,3
       0,30
SS 730 CIRCLE1,55,30,20:CIRCLE
       1,55,30,12:CIRCLE1,55,3
       0,5:PAINT1,55,5
PJ 740 PAINT1,55,23:GOTO920
GM 750 GRAPHIC2,1:CIRCLE1,55,3
       0,30
MR 760 CIRCLE1,45,15,3:CIRCLE1
       ,65,15,3
EP 770 CIRCLE1,55,27,4
QE 780 CIRCLE1,55,35,15,15,90,
       270:GOTO920
PX 790 GRAPHIC2,1:DRAW1,35,5TO
       85,5TO85,15TO80,20TO80,
       10TO30,10TO30,60TO80,60
SA 800 DRAW1,80,60TO85,55TO85,
       45TO45,45TO40,50TO80,50
       TO80,60
FR 810 DRAW1,40,50TO40,40TO80,
       40TO85,35TO85,25TO80,30
       TO40,30TO40,20TO80,20
PH 820 DRAW1,40,30TO45,25TO85,
       25:DRAW1,80,30TO80,40:D
       RAW1,45,40TO45,45
DX 830 DRAW1,35,5TO30,10:DRAW1
       ,80,50TO85,45:DRAW1,85,
       5TO80,10:PAINT1,35,15
FH 840 DRAW1,45,20TO45,25:GOTO
       920
FF 850 GRAPHIC1,1:DRAW1,35,0TO
       25,10TO35,20TO55,0TO75,
       20TO85,10TO75,0TO55,20T
       O35,0
KR 860 DRAW1,25,10TO25,25TO35,
       35TO35,20:DRAW1,35,35TO
       45,25TO45,10
RG 870 DRAW1,45,25TO65,45TO85,
       25TO85,10:DRAW1,55,20TO
       55,35TO65,25TO75,35
EJ 880 DRAW1,65,10TO65,25:DRAW
       1,75,20TO75,50TO65,60TO
       55,50TO45,60TO35,50TO35
       ,35
KP 890 DRAW1,35,35TO45,45TO55,
       35:DRAW1,45,45TO45,60:D
       RAW1,55,35TO55,50
BR 900 DRAW1,65,45TO65,60
MP 910 PAINT1,35,10:PAINT1,55,
       10:PAINT1,75,10:PAINT1,
       45,35:PAINT1,65,35
ER 920 BOX1,20,0,91,62:DRAW1,4
       3,0TO43,62
FF 930 DRAW1,44,0TO44,62:DRAW1
       ,67,0TO67,62:DRAW1,68,0
       TO68,62:DRAW1,20,20TO91
       ,20
KP 940 DRAW1,20,21TO91,21:DRAW
       1,20,41TO91,41:DRAW1,20
       ,42TO91,42:RETURN
EX 950 GRAPHIC1,1:BOX1,25,5,45
       ,25,45
RK 960 DRAW1,35,20TO35,35
RK 970 SCNCLR:FORI=1TO15:POKE2
       41,I:PRINT"{HOME}
       {7 DOWN}{13 RIGHT}TILE
```

```
         {SPACE}TRADER":NEXT
JR 980  PLAY"SAADFFAFDFADFAFDFD
         AFDFDFAFDADFDAFD":RETUR
         N
FR 990  PRINT"{DOWN}PLAY AGAIN
         ";
JC 1000 GETKEYA$:IFA$="Y"THENG
         OSUB1020:PRINT"{CLR}
         {8}":GOTO20
MB 1010 GOSUB1020:PRINT"{CLR}"
         :END
BM 1020 FORI=1TO8:SPRITEI,0,2:
         NEXT:RETURN
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Sprite Manager

See instructions in article on page 80 before typing in.

```
C000:4C 42 C0 4C 40 C2 4C 6B 26
C008:C5 4C 86 C8 4C F7 C2 4C F0
C010:DE C2 4C 13 C3 4C 61 C3 42
C018:4C B7 C2 4C 25 C3 4C 6E 0A
C020:C2 4C 8B C3 4C 19 C5 4C 62
C028:7C C4 4C BC C4 4C A4 C2 D1
C030:4C 48 C3 4C 1F C4 4C 3B 07
C038:C4 4C 67 C4 4C 49 C4 4C C5
C040:FF C3 A9 6D 8D 04 03 A9 EA
C048:C0 8D 05 03 A9 2D 8D 06 81
C050:03 A9 C1 8D 07 03 A9 BD 24
C058:8D 08 03 A9 C1 8D 09 03 F6
C060:A9 E4 8D 0A 03 A9 C1 8D 12
C068:0B 03 4C 13 C7 A6 7A A0 59
C070:04 84 0F BD 00 02 10 07 02
C078:C9 FF F0 3E E8 D0 F4 C9 1F
C080:20 F0 37 85 08 C9 22 F0 2A
C088:56 24 0F 70 2D C9 3F D0 07
C090:04 A9 99 D0 25 C9 30 90 FF
C098:04 C9 3C 90 1D 84 71 A0 9D
C0A0:00 84 0B 88 86 7A CA C8 A9
C0A8:E8 BD 00 02 38 F9 9E A0 B5
C0B0:F0 F5 C9 80 D0 30 05 0B C5
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C0D8:02 F0 DF C5 08 F0 DB C8 74
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C238:36 C0 39 C0 3C C0 3F C0 60
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C9FØ:FØ Ø3 4C BØ CA 4C B2 CA ØA
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CAØ8:55 FØ 58 C9 13 DØ Ø3 4C 5A
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CC7Ø:AA 68 CA 1Ø BA C8 CØ 3F 8D
CC78:DØ B3 4C ØA CC ØØ ØØ ØØ F7
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Ringside Boxing

See instructions in article on page 60 before typing in.

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Ø8Ø9:38 35 ØØ ØØ ØØ AD E8 Ø3 ØE
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Ø831:Ø9 A9 ØØ 8D 4E Ø3 AD 48 2B
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Ø849:2Ø 9B Ø8 A9 13 8D 47 Ø3 4C
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Ø939:Ø4 DØ CE Ø6 DØ 6Ø AD Ø8 27
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Ø979:38 C9 Ø8 9Ø 22 AD ØE DØ D8
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Ø9A9:Ø8 DØ EE ØA DØ EE ØC DØ 9D
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Ø9B9:8D 82 Ø3 AD 15 Ø3 8D 83 C1
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Ø9C9:8D 15 Ø3 A9 ØØ 8D 4A Ø3 BØ
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ØA39:2Ø 56 ØE 2Ø A7 ØD A9 C6 42
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ØA51:A9 ØØ 8D 3C Ø3 8D 3D Ø3 7B
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ØCE9:Ø3 C9 ØA 9Ø Ø8 A9 Ø1 8D B6
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ØD79:3F Ø3 AE 3E Ø3 2Ø CD BD 9F
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1599:57 5C 0D 5F 5C 3B 73 FC D1
15A1:EB C3 AC EC 03 AC EB FF B9
15A9:AB FF FF FF FF 00 03 FC AC
15B1:00 0F FF 00 3F FF 00 3F D8
15B9:00 0F 3F DF 00 3D D5 00 56
15C1:3D 57 00 0D 57 00 0D 5C 62
15C9:00 35 5C 03 55 7F 0D 55 15
15D1:55 0D 5D 55 0D 77 55 0D E8
15D9:55 DD 0D 5D 55 0D 75 7D E8
15E1:0D 5F FB 03 55 EB 00 D5 4A
15E9:EB 00 FF 3C 00 00 00 00 CD
15F1:00 00 00 00 00 00 00 00 1C
15F9:00 00 00 00 00 00 30 00 84
1601:00 EC 00 00 EC 00 03 EB C1
1609:00 0D EB FF F5 7C 55 55 97
1611:C0 55 57 00 55 5C 00 55 4F
1619:70 00 FF C0 00 C0 00 00 8C
1621:C0 00 00 C0 00 00 00 00 B9
1629:00 00 00 00 00 00 03 FC 58
1631:00 03 FF 00 0F FF 00 0F A5
1639:F5 00 0F F7 00 0F 75 00 E8
1641:0F 55 00 03 55 00 0D 5F 9E
1649:00 35 5C 00 F5 7F 03 55 57
1651:55 0D 55 55 35 55 55 37 4C
1659:55 55 37 D5 55 0F D5 5F BB
1661:00 F5 77 00 D5 57 00 D5 DB
1669:57 00 D5 5C 00 00 00 00 C1
1671:C0 00 00 C0 00 00 C0 00 8B
1679:00 C0 00 00 80 00 C0 C0 1C
1681:03 B0 C0 03 B0 00 0F AC F3
1689:00 37 AC FF D5 F0 55 57 8D
1691:00 55 5C 00 55 70 00 55 60
1699:C0 00 FF 00 00 00 00 00 26
16A1:00 00 00 00 00 00 00 00 CD
16A9:00 00 00 00 00 00 0F F0 E4
16B1:00 3F FC 00 FF FC 00 FF 41
16B9:5C 00 FF 7C 00 F7 54 00 64
16C1:F5 5C 00 35 5C 00 35 73 14
16C9:00 D5 73 03 55 73 03 5F E7
16D1:5F 03 55 F5 03 55 57 03 97
16D9:F5 5D 03 5D 77 00 D7 DC D6
16E1:00 F5 5C 00 D5 5C 00 D5 0D
16E9:5C 00 D5 5C 0F 00 00 00 3D
16F1:00 00 00 00 00 00 00 00 1E
16F9:00 3C 00 00 EB 00 00 EB 80
1701:00 00 EC 00 00 70 00 00 8E
1709:70 00 00 EC 00 00 AC 00 97
1711:00 EC 00 00 F0 00 00 40 42
1719:00 00 00 00 00 00 00 00 47
1721:00 00 00 00 00 00 00 00 4F
1729:00 00 00 00 00 00 00 00 57
1731:00 00 00 00 00 00 00 00 5F
1739:00 00 00 00 00 00 00 00 67
1741:00 00 00 00 00 00 00 00 6F
1749:00 00 00 03 00 00 3D CF F1
1751:F0 F5 75 DF F5 55 55 F5 C7
1759:55 D5 FF 55 5D FD 55 77 02
1761:FF 75 55 FF FD 55 3F 0F 6A
1769:55 00 03 FF 00 00 00 00 A2
1771:00 00 00 00 00 00 00 00 9F
1779:00 00 00 00 00 00 00 00 A7
1781:0C 00 00 37 00 00 D5 C0 95
1789:03 55 70 FF 55 70 EA DF BE
1791:70 EA B3 70 EA C3 F0 EA 63
1799:BF B0 EA B5 F2 FA B5 7E F9
17A1:5F ED 7A 57 AD 7A 57 AF 75
17A9:FF FF FF FF 00 00 00 00 D7
17B1:00 00 00 00 00 00 00 00 DF
17B9:00 00 00 00 00 00 00 00 E7
17C1:00 00 00 00 00 00 00 00 EF
17C9:00 00 00 00 30 00 00 B8
17D1:EF 00 00 EE 00 00 EE 00 C4
17D9:00 EE 00 00 3E 00 00 03 B8
17E1:00 00 00 00 00 00 00 00 10
17E9:00 00 00 00 0B 0F F0 00 8E
17F1:3F FC 00 3F FF 00 35 FF 5D
17F9:00 3D FF 00 15 DF 00 35 D4
1801:5F 00 35 5C 00 0D 5C 00 3A
1809:0D 57 00 0D 55 F0 35 55 94
1811:5C D5 5D 5C D5 F5 5C B7 4D
1819:55 5C BF 55 70 D5 57 C0 A2
1821:F5 7D C0 DF D5 C0 35 57 35
1829:00 35 57 00 0F 35 57 00 8D
1831:3F FF 00 3A AA C0 3A AA 1C
1839:C0 3A AA C0 3B AA C0 3F FE
1841:FF 00 37 57 00 37 57 00 59
1849:37 57 00 37 57 00 37 57 DE
1851:00 37 5C 00 0D D7 00 0D AF
1859:D7 00 0D D7 00 0F FF 00 D0
1861:0E EB 00 0E EB 00 3B AB F5
1869:00 FF FF 00 0F 35 57 00 95
1871:3F FF 00 3A AA C0 3A AA 5C
1879:C0 3A AA C0 3B AA C0 3F 3F
1881:FF 00 37 57 00 37 57 00 99
1889:37 57 00 37 57 00 37 57 1F
1891:00 37 5C 00 37 57 C0 35 E8
1899:D5 70 35 F5 70 3F CD EC DF
18A1:3A C3 EB 3A C0 3B EA FF C9
18A9:EB FF FF FF FF 00 00 00 CF
18B1:00 00 00 00 00 00 00 00 E1
18B9:00 00 00 00 0C 00 00 3B 85
18C1:00 00 3B 00 00 EB C0 00 8A
18C9:EB 70 00 3D 5F FF 03 55 36
18D1:55 00 D5 55 00 35 55 00 3C
18D9:0D 55 00 03 FF 00 00 03 19
18E1:00 00 03 00 00 03 00 00 7E
18E9:00 00 00 00 00 3F C0 00 98
18F1:FF F0 00 FF FC 00 D7 FC F2
18F9:00 F7 FC 00 57 7C 00 D5 4A
1901:7C 00 D5 70 00 35 70 00 E8
1909:35 5C 00 FD 55 C0 55 55 7A
1911:70 55 75 70 55 DD 70 77 01
1919:75 70 55 75 70 7D 5D 70 C8
1921:EF F5 70 EB 55 C0 EB 57 72
1929:00 3D FF 00 00 00 00 00 AA
1931:00 00 03 00 00 03 00 00 CF
1939:03 00 00 03 03 00 02 0E 47
1941:C0 03 0E C0 03 3A F0 00 45
1949:3A DC 00 0F 57 FF 00 D5 51
1951:55 00 35 55 00 0D 55 00 09
1959:03 55 00 00 FF 00 00 00 62
1961:00 00 00 00 00 00 00 00 93
1969:00 00 00 00 00 3F C0 00 1A
1971:FF C0 00 FF F0 00 5F F0 0B
1979:00 DF F0 00 5D F0 00 55 C5
1981:F0 00 55 C0 00 F5 70 00 9B
1989:35 5C 00 FD 5F 00 55 55 48
1991:C0 55 55 70 55 55 5C 55 39
1999:55 DC 55 57 DC 75 57 F0 2A
19A1:DD 5F 00 D5 57 00 D5 57 B5
19A9:00 35 57 00 00 00 00 00 14
19B1:00 00 00 00 00 00 00 00 E3
19B9:00 00 00 3C 00 00 EB 00 87
19C1:00 EB 00 00 3B 00 00 0D D5
19C9:00 00 0D 00 00 3B 00 00 8A
19D1:3A 00 00 3B 00 00 0F 00 F2
19D9:00 01 00 00 00 00 00 00 4C
```

```
19E1:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 14
19E9:ØØ ØØ ØØ ØØ ØØ ØF FØ ØØ 3A
19F1:3F FC ØØ 3F FF ØØ 35 FF 61
19F9:ØØ 3D FF ØØ 15 DF ØØ 35 D8
1AØ1:5F ØØ 35 5C ØØ CD 5C ØØ 41
1AØ9:CD 57 ØØ CD 55 CØ F5 F5 66
1A11:CØ 5F 55 CØ D5 55 CØ 75 2F
1A19:5F CØ DD 75 CØ 37 D7 ØØ D2
1A21:35 5F ØØ 35 57 ØØ 35 57 97
1A29:ØØ 35 57 ØØ ØF ØØ ØØ ØØ ØE
1A31:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 65
1A39:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ 6D
1A41:3Ø ØØ ØØ DC ØØ Ø3 57 ØØ 16
1A49:ØD 55 CØ ØD 55 FF ØD F7 FE
1A51:AB ØD CE AB ØF C3 AB ØD 1F
1A59:FE AB 8F 5E AB BD 5E AF 9Ø
1A61:AD 7B F5 AD 7A D5 FF FA ØB
1A69:D5 FF FF FF ØØ ØØ ØØ ØØ 88
1A71:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ A5
1A79:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ AD
1A81:ØØ ØØ ØØ ØØ ØØ ØØ ØØ ØØ B5
1A89:ØØ ØØ ØØ ØØ ØØ CØ ØF F3 D2
1A91:7C F7 5D 5F 55 55 5F 57 B9
1A99:55 5F 75 55 FF DD 55 7F F5
1AA1:55 5D FF 55 7F FF 55 FØ C4
1AA9:FC FF CØ ØØ ØØ ØØ ØØ ØØ 74
```

BEFORE TYPING . . .

Before typing in programs, please refer to "How To Type In COMPUTE!'s GAZETTE Programs," which appears before the Program Listings.

Horizons: Memory Display

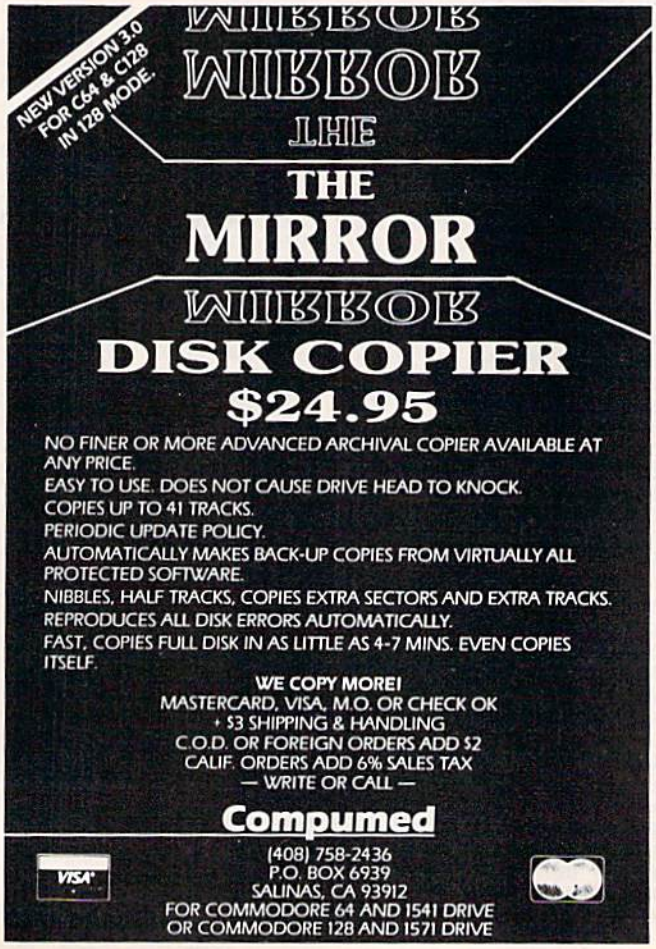
See instructions in article on page 89 before typing in.

```
CØØØ:A9 ØØ 85 FB A9 Ø8 85 FC 3C
CØØ8:2Ø 14 C1 2Ø 22 C1 2Ø CA FB
CØ1Ø:CØ A9 1Ø 8D 9B C1 2Ø D3 2F
CØ18:CØ 2Ø FØ CØ A9 Ø8 18 65 2F
CØ2Ø:FD 85 FD 9Ø Ø2 E6 FE CE 43
CØ28:9B C1 DØ EA 2Ø E4 FF FØ 36
CØ3Ø:FB AØ Ø4 D9 8C C1 FØ Ø5 48
CØ38:88 1Ø F8 3Ø EF 98 ØA A8 C2
CØ4Ø:B9 91 C1 8D 4E CØ C8 B9 D4
CØ48:91 C1 8D 4F CØ 4C FF FF EØ
CØ5Ø:A5 FB 18 69 8Ø 85 FB 9Ø DF
CØ58:Ø2 E6 FC 4C Ø8 CØ A5 FB 83
CØ6Ø:38 E9 8Ø 85 FB BØ Ø2 C6 4E
CØ68:FC 4C Ø8 CØ A9 3A 2Ø D2 D1
CØ7Ø:FF 2Ø 44 C1 A9 ØØ 8D 9B A2
CØ78:C1 2Ø E4 FF FØ FB C9 14 9E
CØ8Ø:FØ 39 A2 ØF DD 4A C1 FØ 9A
CØ88:Ø5 CA 1Ø F8 3Ø EB 2Ø D2 15
CØ9Ø:FF AC 9B C1 8A 99 9C C1 82
CØ98:C8 8C 9B C1 CØ Ø4 DØ D9 C2
CØAØ:AD 9C C1 ØA ØA ØA ØA ØD 92
CØA8:9D C1 85 FC AD 9E C1 ØA 5F
CØBØ:ØA ØA ØA ØD 9F C1 85 FB D6
CØB8:4C Ø8 CØ AE 9B C1 FØ B9 E4
CØCØ:CE 9B C1 2Ø D2 FF 4C 79 73
CØC8:CØ 6Ø A5 FB 85 FD A5 FC A3
CØDØ:85 FE 6Ø A5 FE 2Ø 2F C1 D3
CØD8:A5 FD 2Ø 2F C1 2Ø 44 C1 7C
CØEØ:AØ ØØ B1 FD 2Ø 2F C1 2Ø 2A
CØE8:44 C1 C8 CØ Ø8 DØ F3 6Ø ED
CØFØ:2Ø 44 C1 A9 12 2Ø D2 FF 1D
CØF8:AØ ØØ B1 FD AA 29 7F C9 A3
C1ØØ:2Ø BØ Ø2 A2 A4 8A 2Ø D2 8C
C1Ø8:FF C8 CØ Ø8 DØ EC A9 ØD FØ
C11Ø:2Ø D2 FF 6Ø AØ ØØ B9 5A 31
C118:C1 FØ Ø6 2Ø D2 FF C8 DØ 74
C12Ø:F5 6Ø A6 FB A5 FC 2Ø CD 7A
C128:BD A9 ØD 2Ø D2 FF 6Ø 48 38
C13Ø:29 FØ 4A 4A 4A 4A 2Ø 3C 6A
C138:C1 68 29 ØF AA BD 4A C1 6F
C14Ø:2Ø D2 FF 6Ø A9 2Ø 2Ø D2 6F
C148:FF 6Ø 3Ø 31 32 33 34 35 F8
C15Ø:36 37 38 39 41 42 43 44 35
C158:45 46 93 12 3Ø 92 3D 41 2B
C16Ø:47 41 49 4E 2Ø 12 2B 92 18
C168:3D 46 57 44 2Ø 12 2D 92 81
C17Ø:3D 42 41 43 4B 2Ø 12 5C DA
C178:92 3D 53 45 4C 45 43 54 A5
C18Ø:2Ø 12 51 92 3D 51 55 49 ØF
C188:54 ØD ØD ØØ 3Ø 2B 2D 5C FF
C19Ø:51 Ø8 CØ 5Ø CØ 5E CØ 6C 49
C198:CØ C9 CØ ØØ ØØ ØØ ØØ ØØ Ø7
```

ROM Enhancer

See instructions in article on page 85 before typing in.

```
CØØØ:4C 1C CØ A5 Ø3 8D Ø2 Ø3 76
CØØ8:A5 Ø4 8D Ø3 Ø3 A9 37 85 F1
CØ1Ø:Ø1 A5 Ø5 8D 18 Ø3 A5 Ø6 13
CØ18:8D 19 Ø3 6Ø AD Ø2 Ø3 85 ØE
CØ2Ø:Ø3 AD Ø3 Ø3 85 Ø4 AD 18 CE
CØ28:Ø3 85 Ø5 AD 19 Ø3 85 Ø6 ED
CØ3Ø:A9 AØ 8D 48 CØ 8D 4B CØ 78
CØ38:AØ ØØ 8C 47 CØ 8C 4A CØ 9D
CØ4Ø:8C 65 CØ 8C 68 CØ B9 ØØ FB
CØ48:CØ 99 ØØ CØ C8 DØ F7 EE Ø5
CØ5Ø:48 CØ EE 4B CØ AE 48 CØ CA
CØ58:EØ CØ DØ EA A9 EØ 8D 66 95
CØ6Ø:CØ 8D 69 CØ B9 ØØ ØØ 99 46
CØ68:ØØ ØØ C8 DØ F7 EE 66 CØ 19
CØ7Ø:EE 69 CØ AE 66 CØ DØ EC 8B
CØ78:A9 Ø8 8D DA E1 A9 EA AØ 5C
CØ8Ø:Ø6 99 FC AB 88 DØ FA A9 EC
CØ88:2Ø 8D AØ A8 A9 7D 8D A1 1C
CØ9Ø:A8 A9 C1 8D A2 A8 A9 5Ø 3D
CØ98:8D 24 AØ A9 C1 8D 25 AØ C7
CØAØ:A9 4C 8D 2B A9 8D 8D B3 CØ
CØA8:A9 68 8D 2C A9 A9 C1 8D 92
CØBØ:2D A9 A9 91 8D ØC AD A9 23
CØB8:ØØ 8D ØD AD 8D FC AC A9 7D
CØCØ:2B 8D 8E B3 A9 C1 8D 8F 47
CØC8:B3 A9 Ø5 8D 2Ø AØ A9 C1 AØ
CØDØ:8D 21 AØ A9 3F 8D C6 AA 78
CØD8:A9 Ø5 8D 8F B7 A9 ØF 8D 2B
CØEØ:5Ø EC A9 FE 8D 7C A9 A9 46
CØE8:3D 8D Ø2 Ø3 A9 C1 8D Ø3 4F
CØFØ:Ø3 6Ø A9 Ø4 8D 88 Ø2 A9 BD
CØF8:ØØ AØ 19 99 ØØ D4 88 1Ø D3
C1ØØ:FA 85 F8 6C Ø5 ØØ Ø8 C9 4A
C1Ø8:22 DØ 1C 28 2Ø D4 E1 A9 98
C11Ø:ØØ A6 2B A4 2C 2Ø 83 C1 97
C118:A9 ØØ 2Ø 9Ø FF 2Ø D7 AA 58
C12Ø:EA EA EA EA 4C 7A A8 28 A5
C128:4C 71 A8 A5 34 E5 32 A2 DD
C13Ø:ØØ 86 ØD 85 62 84 63 A2 DD
C138:9Ø 38 4C 49 BC A9 F2 8D 3Ø
C14Ø:18 Ø3 A9 CØ 8D 19 Ø3 A9 52
C148:35 85 Ø1 6C Ø3 ØØ 4C 1D 7C
C15Ø:A8 FØ FB 2Ø 7D C1 2Ø 13 2C
C158:A6 38 A5 5F E9 Ø1 A4 6Ø E4
C16Ø:BØ Ø1 88 85 41 84 42 6Ø E6
C168:2Ø 79 ØØ C9 89 DØ Ø3 4C D8
C17Ø:37 A9 C9 8D FØ F9 C9 99 A8
C178:FØ F5 4C 32 A9 2Ø 8A AD 2F
C18Ø:4C F7 B7 2Ø D5 FF BØ Ø8 39
C188:86 2D 84 2E 2Ø 33 A5 6Ø 87
C19Ø:AØ FF C8 B9 A1 C1 2Ø D2 4Ø
C198:FF DØ F7 28 A2 8Ø 6C ØØ C1
C1AØ:Ø3 ØD ØD 4C 4F 41 44 2Ø 77
C1A8:45 52 52 4F 52 ØØ ØØ ØØ 35
```



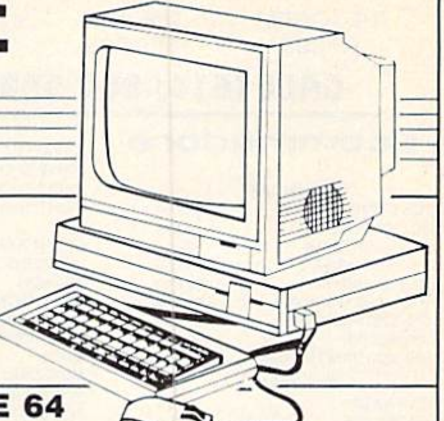
bug-swatter

• "Connect 'Em" (January) doesn't check to see whether you enter the names for the players. If you accidentally press RETURN without typing in a name, BASIC responds with ILLEGAL QUANTITY ERROR IN 770. To correct this problem, add the following line to the program:

```
BR 755 IF PL$(I)="" THEN 750
```

Connect 'Em allows you to choose between two different boards: the regular board and the miniboard. If you choose the miniboard, Connect 'Em works fine, but if you choose the regular board, it doesn't recognize the end-of-game situation. This problem is easily corrected by changing the value assigned to TS (in line 720 of the 64 version or in line 670 in the 128 version) from 84 to 77. These lines set the variable TS to the highest possible score, the score when all the squares have been completed. When the sum of the players' scores equals this value, there are no squares left to be filled, so the end-of-game situation is satisfied.

YOUR COMMODORE CONNECTION



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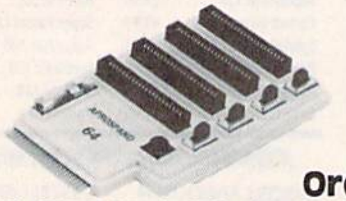

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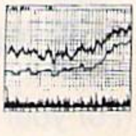

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news & products

128 Accounting Program

Softsync has announced the introduction of a new integrated accounting package, *Accountant, Inc.*, for the Commodore 128.

The $99.95 package takes advantage of the 128's memory capacity and its 80-column capacity, and is based on three modules: General Ledger, Accounts Receivable, and Accounts Payable. The program generates key financial reports, including Trial Balance, Income Statement, a Balance Sheet, and audit trails. Balances and aging reports are available within the Accounts Receivable and Accounts Payable modules. In addition, account histories, exception reports, and monthly statements can be created.

The General Ledger will handle 140 accounts on a disk, with no limit to the number of disks used. Accounts Receivable and Accounts Payable will each handle up to 960 customer and vendor accounts. No knowledge of accounting is required to use the package. The program guides the user through the entry process and uses easy-to-follow prompts.

Minimum requirements are a 128, an 80-column monitor, and a dot matrix printer. A condensed mode feature is required on the printer, although most 80-column printers already have this option.

Among Softsync's other Commodore 64 and 128 programs are *The Personal Accountant*, a double-entry bookkeeping system that generates accounting reports and calculates loan payment schedules; *Desk Manager*, which combines a letter writer, appointment schedule, phone book, notepad, and calculator into one program; and *Trio*, an integrated word processor, spreadsheet, and database on a single disk.

Softsync, 162 Madison Ave., New York, NY 10016

Circle Reader Service Number 220.

EPROMs For The 64 And 128

Epimetheus Corporation has introduced its 128K ROMDISK with *Hyperboot* for the 64 and 128. The package combines all the hardware and software you need to create a library of up to 150 programs on an EPROM (Erasable Programmable Read Only Memory) bank attached to the user port.

Transferring program files from a 1541 disk drive to the ROMDISK is carried out with a menu-driven program called *Hyperboot*, which is provided on an 8K cartridge. Once programs are transferred from the disk to the ROMDISK, they can be loaded at a rate of 128,000 baud.

The ROMDISK comes in a finished case with all 128K of EPROM installed. It is erasable using ultraviolet light, and can be reprogrammed thousands of times. Also available are two-way switches ($39) that allow both a modem and the ROMDISK to occupy the user port, and 3-foot ribbon wire extension cables ($24.95) to allow remote placement of the ROMDISK or a modem.

ROMDISK with *Hyperboot* sells for $179.

Epimetheus Corp., P.O. Box 171, Clear Creek, IN 47426

Circle Reader Service Number 221.

Accolade Murder Mystery And Other Games

A new text-and-graphics murder mystery game and a line of mid-priced entertainment programs have been announced by Accolade Software for the Commodore 64.

Killed Until Dead is a murder mystery that allows the user to control the direction and sequence of the game and features more than 20 plots. The program, similar to an Agatha Christie mystery, has five characters—one of whom will attempt to commit the perfect murder. The player has the role of Hercule Holmes, master sleuth, who will try to solve the mystery before the murder hour—midnight. Time is tracked by a continuously running clock that begins at noon, when Holmes takes the case, and ends at midnight—about 24 minutes in playing time.

Using joystick-controlled commands, the program simulates the options facing a real detective. Holmes can gather information in three ways: character profiles, a video-telephone, and a surveillance machine. The player reads about the characters, interviews them, and can even monitor supects, break into rooms (after answering trivia questions), and tape conversations,

The Commodore 64 version of *Killed Until Dead* has a suggested retail price of $29.95.

Accolade has also introduced a new line of mid-priced computer games for the 64 under the Avantage brand name. Priced at $14.95 each, the first three games in this line are *Spy Vs. Spy I & II*, two graphic adventures in one package (previously marketed separately by First Star Software) based on the *MAD Magazine* cartoon characters; *Desert Fox*, a historical recreation of the World War II confrontation between German Field Marshall Erwin Rommel and the British North African Command; and *Deceptor*, a futuristic arcade-style graphic adventure game in which the character can transform from land rover to robot to space vehicle.

Accolade, 20833 Stevens Creek Blvd., Cupertino, CA 95014

Circle Reader Service Number 222.

Utilities And Oxford Pascal

A programming utility package for the 128 and versions of *Oxford Pascal* for both the Commodore 64 and 128 have been released by Metacomco.

Hack-Pack is a $39.95 utility pack for 128 programmers that contains a Toolkit for BASIC programmers, a RAM disk compatible with the 1541 and 1571 drives, and a program compressor to make programs smaller and faster.

The Toolkit provides eight new BASIC commands, including features such as FIND, to locate any string in a BASIC program; CHANGE, to replace any sequence of characters; DUMP, to list all variables, arrays, and functions; MERGE, to join two BASIC programs; and others. The RAM disk responds to all the usual disk commands and behaves just like a floppy drive but operates much faster. The Compressor condenses programs down to their minimum size, removing all spaces and REMs and allowing up to 255 characters per line.

Metacomco's *Oxford Pascal* for the 64 ($34.95) and for the 128 ($49.95) are each extended full implementations of Pascal. Features include every... found in the Jensen and ... definition of the ... of graph...

take advantage of the 64 and the 128. The 64 version comes in either tape or disk versions.

Metacomco, 5353E Scotts Valley Dr., Scotts Valley, CA 95066

Circle Reader Service Number 223.

Kyan Pascal/128

A version of *Kyan Pascal* for the Commodore 128 has been released by Kyan Software. *Kyan Pascal/128* is a fully validated implementation of ISO Pascal and features a native code compiler running in true 128 mode. Designed for both students and advanced programmers, this program can be used to learn the Pascal programming language and to develop programs.

The program includes a full-screen (80-column) text editor, a native code compiler, a macro-assembler, and programming utilities. It also features many Pascal extensions, such as "include" files, object module chaining, string handling, random files, random numbers, and Commodore graphics. Also, the built-in macro assembler allows programmers to add in-line assembly source code to their Pascal programs. The code generated by Kyan Pascal is reported to run more than 30 times faster than BASIC.

The software is not copy protected, and there are no royalty charges for use of the Kyan Pascal Runtime Library. *Kyan Pascal/128* and *Kyan Pascal/64* are each available for $69.95.

Kyan Software, 1850 Union St., #183, San Francisco, CA 94123

Circle Reader Service Number 224.

New 64 And 128 Database

Professional Software has introduced *Fleet Filer*, a database that is compatible with the company's *Fleet System 2* word processor and dictionary for the 64 and *Fleet System 3* word processor and dictionary for the 128.

Fleet Filer is capable of handling up to 5,000 records and 22 fields (text and numeric). Text fields are capable of having up to 255 characters, and the system can sort records in ascending or descending order. There is a multifield pattern-searching mode that allows you to either search according to logical criteria or search string. In addition, the program lets the user choose any of several mathematical functions, including addition, subtraction, multiplication, and division, and can print some or all of a selection of fields.

A file can be created on *Fleet System 2* or *Fleet System 3* and then can be used in *Fleet Filer*. The *Fleet Filer* can be purchased with the *Fleet System 3* for $79.95 or with the *Fleet System 2* for $69.95. The program can also be purchased separately or as an add-on for $39.95.

Professional Software, 51 Fremont St., Needham, MA 02194

Circle Reader Service Number 225.

Graphics Scrapbook

Epyx has introduced the *Graphics Scrapbook*, a series of specialized graphics disks compatible with Brøderbund's *The Print Shop* and Unison World's *PrintMaster* specialized printing programs. The first two chapters in the series are Sports and Off The Wall.

The sports disk provides an assortment of sports graphics, such as basketball, football, hockey, bowling, gymnastics, swimming, martial arts, and many others. The Off The Wall disk contains more than 100 funny and offbeat graphics reflecting contemporary tastes and symbols. Punk teddy bears, flamingos, bizarre animals, international symbols, body parts, high-tech symbols, and many others are included.

Check with local dealers for the retail price.

Epyx, 600 Galveston Dr., P.O. Box 8020, Redwood City, CA 94063

Circle Reader Service Number 226.

Arcade Action

Spinnaker Software has introduced two new products in its UXB line of entertainment programs, available for the Commodore 64.

The new titles are *Z-Pilot* ($9.95), an air combat simulation game, and *Strike Force: Cobra* ($19.95), an arcade-action adventure from Great Britain.

In *Z-Pilot*, you're at the controls of a futuristic, high-performance jet fighter equipped with a state of the art guidance system. In *Strike Force: Cobra*, your mission is to infiltrate the enemy's fortress, disable the computer system, and stop a plot that would control all of the world's nuclear weapons. The games are for players age nine and older.

Spinnaker Software, One Kendall Square, Cambridge, MA 02139

Circle Reader Service Number 227.

New Electronic Arts Games

Commodore 64 versions of a sailing simulation, a crossword puzzle game, and two popular fantasy role-playing games are among the new releases from Electronic Arts.

The Official America's Cup Sailing Simulation ($24.95) is a one or two-player game that puts you at the helm of a 12-meter yacht on the Perth, Australia, America's Cup course. You complete an eight-leg race across a triangular course which covers more than 24.1 nautical miles. Three-dimensional graphics, actual sailing tactics, a complete instrument panel, and sounds of the wind are all a part of the game. Players have a choice of three genoas and three spinnaker sails, with a range of six headsails. There are three levels of play and a manual with information on sailing, the America's Cup, and this year's actual contest.

Computer Scrabble ($32.95) is a computerized version of the classic board game. Players have four difficulty levels to choose from, and can go one-on-one with the computer or play with up to three other people. The game includes a playing vocabulary from 12,000 to 20,000 words (depending on which computer version is used), and has a built-in word speller that doublechecks each move.

Moebius: The Orb of Celestial Harmony ($39.95) is a fantasy role-playing game created by Origin Systems, developers of the popular Ultima series of role-playing games, and distributed by Electronic Arts. The game combines three-dimensional graphics with portrayals of karate and sword-fighting sequences and displays of magic and character interaction. The goal is to recover a magical orb which has been stolen by a renegade warlord who is using it to upset the environmental harmony of the island kingdom of Khantun.

On the heels of the popular fantasy game, *The Bard's Tale*, Electronic Arts is releasing *The Bard's Tale II: The Destiny Knight* ($39.95). This sequel is more challenging than the original and features an expanded dominion for exploration and adventure with advanced combat and magic systems. *The Bard's Tale II* revolves around your attempts to halt an evil force threatening to destroy the Realm. In addition to Conjurers, Magicians, sorcerers, and wizards, a new class of magic user, the Archmage, may also be acquired.

Electronic Arts, 1820 Gateway Dr., San Mateo, CA 94404

Circle Reader Service Number 228.

Leader Board Course Disk

Access Software has introduced two new golf courses on a disk for use with the *Leader Board* golf simulation for the Commodore 64.

Famous Courses of the World ($19.95) now features both Augusta and Pinehurst golf courses, complete with accurate distances, traps, water hazards, and roughs. Other features in the game are computerized scoring, a handicap system, and strategy decisions involving the choice of club, distance, and other variables. The course disk requires the original *Leader Board* game to be used.

Access Software, 2561 South 1560 West, Woods Cross, UT 84087

Circle Reader Service Number 229.

COMPUTE!'s GAZETTE Author's Guide

Here are some suggestions which serve to improve the speed and accuracy of publication for prospective authors. COMPUTE!'s GAZETTE is primarily interested in new and timely articles on the Commodore 128, 64, Plus/4, and 16. We are much more concerned with the content of an article than with its style, but articles should as be clear and well-explained as possible.

The guidelines below will permit your good ideas and programs to be more easily edited and published:

1. The upper left corner of the first page should contain your name, address, telephone number, and the date of submission.

2. The following information should appear in the uppe' right corner of the first page. If your article is specifically directed to one model of computer, please state the model name. In addition, *please indicate the memory requirements of programs.*

3. The underlined title of the article should start about 2/3 of the way down the first page.

4. Following pages should be typed normally, except that in the upper right corner there should be an abbreviation of the title, your last name, and the page number. For example: Memory Map/Smith/2.

5. All lines within the text of the article must be double- or triple-spaced. A one-inch margin should be left at the right, left, top, and bottom of each page. No words should be divided at the ends of lines. And please do not justify. Leave the lines ragged.

6. Standard typing or computer paper should be used (no erasable, onionskin, or other thin paper) and typing should be on one side of the paper only (upper- and lowercase).

7. Sheets should be attached together with a paper clip. Staples should not be used.

8. If you are submitting more than one article, send each one in a separate mailer with its own tape or disk.

9. Short programs (under 20 lines) can easily be included within the text. Longer programs should be separate listings. *It is essential that we have a copy of the program, recorded twice, on a tape or disk.* If your article was written with a word processor, we also appreciate a copy of the text file on the tape or disk. Please use high-quality 10 or 30 minute tapes with the program recorded on both sides. The tape or disk should be labeled with the author's name and the title of the article. Tapes are fairly sturdy, but disks need to be enclosed within plastic or cardboard mailers (available at photography, stationery, or computer supply stores).

10. A good general rule is to spell out the numbers zero through ten in your article and write higher numbers as numerals (1024). The exceptions to this are: Figure 5, Table 3, TAB(4), etc. Within ordinary text, however, the zero through ten should appear as words, not numbers. Also, symbols and abbreviations should not be used within text: use "and" (not &), "reference" (not ref.), "through" (not thru).

11. For greater clarity, use all capitals when referring to keys (RETURN, CTRL, SHIFT), BASIC words (LIST, RND, GOTO), and the language BASIC. Headlines and subheads should, however, be initial caps only, and emphasized words are not capitalized. If you wish to emphasize, underline the word and it will be italicized during typesetting.

12. Articles can be of any length—from a single-line routine to a multi-issue series. The average article is about four to eight double-spaced, typed pages.

13. If you want to include photographs, they should be either 5×7 black and white glossies or color slides.

14. We do not consider articles which are submitted simultaneously to other publishers. If you wish to send an article to another magazine for consideration, please do not submit it to us.

15. COMPUTE!'s GAZETTE pays between $70 and $800 for published articles. In general, the rate reflects the length and quality of the article. Payment is made upon acceptance. Following submission (Editorial Department, COMPUTE!'s GAZETTE, P.O. Box 5406, Greensboro, NC 27403) it will take from two to four weeks for us to reply. If your work is accepted, you will be notified by a letter which will include a contract for you to sign and return. *Rejected manuscripts are returned to authors who enclose a self-addressed, stamped envelope.*

16. If your article is accepted and you have since made improvements to the program, please submit an entirely new tape or disk and a new copy of the article reflecting the update. We cannot easily make revisions to programs and articles. It is necessary that you send the revised version as if it were a new submission entirely, but be sure to indicate that your submission is a revised version by writing, "Revision" on the envelope and the article.

17. COMPUTE!'s GAZETTE does not accept unsolicited product reviews. If you are interested in serving on our panel of reviewers, contact our Features Editor for details.


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